MRL LifeQuest
Automatic External Defibrillator

MRL LifeQuest AEDefibrillator

Service Manual

The First Choice in Resuscitation Solutions

MRL Part Number 990024 - Revision B

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Preface

MRL LifeQuest AEDefibrillator Service Manual

WARNING!

Do not attempt to use the MRL LifeQuest AEDefibrillator without thoroughly reading and understanding this manual and the accompanying MRL LifeQuest AEDefibrillator Users Manual.

Forward

The MRL LifeQuest AEDefibrillator Service Manual is intended to provide the technical information required for proper maintenance of the Medical Research Laboratories, Inc. (MRL) Automatic External Defibrillation (AED) system. The information is subject to change without notice. Revisions or amendments should be added as they become available.

Servicing and performance verification must be undertaken only by authorized personnel who are trained in the particular skills required to maintain original, factory-approved specifications.

Component substitution or unauthorized replacement may result in a hazardous performance deficiency.

Manufacturer Information

Manufacturer	Medical Research Laboratories, Inc. 1000 Asbury Drive Buffalo Grove, IL 60089 USA (847) 520-0300
Product Name	MRL AEDefibrillator MRL LifeQuest
Device Type	Automatic External Defibrillator (AED)

MRL is responsible for the safety, reliability, and performance of the MRL AED, only if the following conditions are met:

- Only persons authorized by MRL are permitted to perform assembly operations, extensions, readjustments, modifications, or repairs.
- The MRL AED system is used in accordance with the instructions for use as covered in the separate *MRL LifeQuest AEDefibrillator Users Manual*.

Contact and Technical Support

Please contact MRL if you have any questions.

Telephone	847.520.0300
Toll-free	800.462.0777
Fax	847.520.0303
Internet	www.mrlinc.com
E-mail	info@mrlinc.com

Warranty

Medical Research Laboratories warrants the MRL LifeQuest AEDefibrillator against defects in workmanship, materials, and construction under normal use and service. Some exclusions or restrictions may apply. For a copy of the warranty, please contact your MRL representative.

Conventions Used in the Manual

This manual uses the following formatting conventions for warnings, cautions, and notes.

Warnings

Warnings alert the user to a special condition that could result in serious personal injury or death. In this manual, warnings are displayed as shown in the following example:

WARNING!

Conditions, hazards, or unsafe practices that can result in serious personal injury or death.

Cautions

Cautions alert the user to a special condition that could result in minor personal injury or damage to the equipment. In this manual, cautions are displayed as shown in the following example:

Caution

Conditions, hazards, or unsafe practices that can result in minor personal injury, damage to the MRL LifeQuest AEDefibrillator, or loss of data.

Notes

Notes contain information that augments or clarifies an operating step. Notes follow the procedural steps to which they refer. In this manual, notes are displayed as shown in the following example:

> *If the MRL AED is used more than once per month, it is recommended that authorized service personnel perform a periodic inspection servicing at least once per year.*

Safety Information

Safety information is organized into six groups:

- General Cautions and Notices
- Patient Safety
- Defibrillator and Electrodes Pads
- Battery and Charger
- Care and Storage
- Safety Symbols

General Cautions and Notices

Dropped or Damaged

If the device has been dropped or damaged in any way, refer the device to qualified service personnel for servicing.

Ferromagnetic Equipment

ECG electrodes and cables contain ferromagnetic materials. They must not be used in the presence of large magnetic fields created by magnetic resonance imaging (MRI) equipment. The large magnetic fields generated by MRI equipment could move ferromagnetic devices with an extremely violent force that could cause serious personal injury or death to persons between the devices and the MRI equipment.

Labels Observe all CAUTION and WARNING labels on the equipment and accessories.

Performance

The MRL AED may not meet performance specifications if stored, transported or used outside the specified storage or operating environmental range limits.

Notices U.S. Federal law restricts this device to use by or on the order of a physician. If the battery pack is removed for any reason, the MRL AED must be labeled as *out-of-service for battery operation*.

Patient Safety

General

Caution **Patient Physical Harm**
Place the MRL AEDefibrillator in a position where it cannot harm the patient should it fall. Keep all cables and connectors away from the patient's neck.

Caution **Use Automatic Mode only under approved conditions**
Use Automatic Mode only on victims of cardiac arrest who exhibit unconsciousness, absence of breathing, and absence of pulse.

Shock Hazard

Warning **Defibrillation current can cause injury**
Do not touch the patient during defibrillation. Do not touch equipment connected to or metal objects in contact with the patient during defibrillation. Disconnect other electrical equipment from the patient before defibrillating.

Caution **Manual mode is for qualified users**
Only qualified operators who have been trained in rhythm recognition and treatment through manual charging and delivery of defibrillation shocks should use Manual Mode. Follow all instructions in the *MRL LifeQuest AEDefibrillator Users Manual.*

Burns

Warning **Properly place defibrillation pads**
Do not allow defibrillation pads to touch each other or to touch other ECG electrodes, lead wires, dressings, transdermal patches, etc. Such contact can cause patient skin burns during defibrillation and may divert defibrillating current away from the heart. Remove excessive body hair, which may cause skin burns or ineffective energy transfer.

Warning **Not for use on Pediatric patients**
This defibrillator is not to be used on persons less than 8 years old.

Electrical Energy

Warning **MRL AED can deliver 360 joules of electrical energy**
Before charging the defibrillator, verify that the energy selected on the display is the desired output. Disconnect any medical electronic device that is not labeled “defibrillation protected” from the patient. If the electrical energy is not discharged properly, it could cause personal injury or death to the operator or bystander. During defibrillation, the operator and all other people must stand clear of the patient, bed, and all conductive surfaces in contact with the patient.

Warning **Properly place defibrillation pads**
Do not place electrodes near the generator of an internal pacemaker. Always apply electrodes to flat areas of skin. Avoid application over folds of skin such as those underneath the breast or on obese patients. Excessive hair, poor adhesion, or air under the electrodes may cause skin burns.

ECG Misinterpretation

Warning **Properly place defibrillation pads**
Improperly placed pads may produce incorrect analysis and an inappropriate shock or no shock decision advisory.

Warning **Do not move patient**
Handling or transporting the patient during ECG analysis can cause incorrect or delayed diagnosis. Follow all instructions in the *MRL LifeQuest AEDefibrillator Users Manual*.

Warning **Cardiac pacemakers may affect rhythm analysis**
A cardiac pacemaker may reduce the sensitivity of the MRL AED analysis and result inn errors in detecting shockable rhythms.

Warning **Radio frequency (RF) interference**
RF devices such as a cellular phone or two-way radio may cause the MRL AED to operate improperly. Maintain a recommended distance of 2 meters (8 feet) between RF devices and the MRL AED. Do not operate the MRL AED in conjunction with electrocautery or diathermy equipment. Any equipment that emits strong radio frequency signals can cause electrical interference and distort the ECG signal to cause inaccurate interpretation of rhythm.

Defibrillator and Electrode Pads

Explosion

Warning **Explosion hazard**
Do not use the MRL AED in the presence of flammable anesthetics or concentrated oxygen.

Electrical Shock or Fire Hazard

Warning **No internal, operator-serviceable parts**
Do not open unit, remove covers or attempt to repair the MRL AED. All servicing must be performed by qualified personnel.

Warning **Improper use can cause injury**
The MRL AED contains an automatic disarm of the stored energy. If the operator has not delivered the energy to a patient or a test load, an internal timer will disarm the stored energy. This stored electrical energy has the potential to cause death or injury if discharged improperly. Follow all instructions in the *MRL LifeQuest AEDefibrillator Users Manual*.

Caution **Do not immerse or expose the MRL AED to water or other liquids**
Do not use the defibrillator if unit has been immersed in liquid or if excessive condensation is visible on the device.

Caution **Conductive parts should not contact other conductive parts including the earth**
Follow all instructions in the *MRL LifeQuest AEDefibrillator Users Manual.*

Improper Device Performance

Warning **Use only MRL-approved accessories**
Do not use defibrillation pads, batteries, and other accessories not approved by MRL. Use of unauthorized accessories may cause the device to operate improperly and provide false measurements. Follow all labeling instructions on the defibrillation pads and the rechargeable battery.

Caution **Do not repeatedly charge and discharge the MRL AED in rapid succession**
Wait at least 1 minute for every third discharge to avoid damaging equipment.

Caution **Improper maintenance can cause improper performance**
Follow instructions in the *MRL LifeQuest AEDefibrillator Users Manual*.

Caution **Use Manual Mode properly**
In the manual mode, if a new energy level is selected after the charge button is pushed and while the defibrillator is charging, the defibrillator will automatically charge to the new energy selection. The CHARGE button need not be pressed again to select the new energy level.

Battery and Charger

Battery Care

Caution **Battery is shipped discharged**
Charge the rechargeable battery fully before the MRL AED is used.

Caution **Use only MRL PowerStick batteries**
Use either the rechargeable NiMH PowerStick or the non-rechargeable Lithium PowerStick. Using any other battery can damage the MRL AED.

Caution **Make sure the rechargeable battery is fully charged**
Loss of power during patient care could result in injury. Always have a fully charged back-up battery available.

Caution **Replace a non-rechargeable battery after every use**
Follow instructions in the *MRL LifeQuest AEDefibrillator Users Manual*.

Caution **Replace battery at 24 months**
Battery replacement at 24 months is recommended due to degradation of the battery chemistry. Periodic maintenance and testing is highly recommended to ensure proper battery performance.

Charger Care

Caution **Use the battery charger to maintain a full battery charge**
Make sure the charger is plugged into an AC power source. Keep the battery charger in a dry, moisture-free location, away from direct sunlight or other heat sources.

Care and Storage

Cleaning and Sterilization

Caution **Clean and maintain the MRL AED according to instructions. See Chapter 5, *Maintenance* in the *MRL LifeQuest AEDefibrillator Users Manual.***
Do not clean the MRL AED with alcohol, ketone, or any flammable agent. Do not autoclave the MRL AED or attempt to sterilize the MRL AED or any of its accessories.

Electrodes

Warning **Follow the manufacturer s instructions for use of defibrillation electrodes**
Improper use of defibrillation electrodes may cause the MRL AED to function improperly or may cause skin burns. Do not use expired, dry electrodes. Do not reuse disposable electrodes. Verify that new electrodes connect properly to the MRL AED prior to putting them into service.

Caution **Properly store and use defibrillation pads**
Store electrodes in a cool, dry location between 60° and 95°F (15° and 35°C). Do not sterilize, immerse, or clean the pads and electrodes with alcohol or solvents.

Safety Symbols

Graphical symbols, letter symbols, and signs listed below may be found on the MRL AED and accessories. Please note the purpose of these symbols is for safe and proper use of the equipment.

For a complete list of icons that display operating status information, see Chapter 1 *General Information.*

Attention, consult accompanying documents

Earth (ground)

Auxiliary power operation

Negative input terminal

Caution, high voltage

Positive input terminal

Dangerous voltage

Recycle battery

Defibrillator protected, type BF patient connection

Chapter 1

General Information

MRL LifeQuest AEDefibrillator Service Manual

This chapter provides an introduction to the MRL LifeQuest AEDefibrillator Service Manual. It presents an overview of the MRL AED system and its controls, indicators, displays, and prompts. The chapter also contains information on battery charging and conditioning, and instructions on preparing the unit for storage.

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Overview of the MRL AED

The MRL AED (automatic external defibrillator) is a safe, easy to use defibrillation device designed for use by basic life support (BLS) personnel. The unit is lightweight and mobile and can be used in situations where several minutes could elapse before the arrival of advanced life support (ALS) personnel.

The MRL AED recognizes ventricular fibrillation and other ventricular tachycardia and guides operators through the defibrillation process. When properly connected to a patient who is unconscious, not breathing, and without a pulse, the MRL AED analyzes the patient's heart rhythm, provides text and audio instruction prompts, determines if a shockable situation exists, and, if appropriate, automatically arms the shock button.

The MRL AED delivers the defibrillation shock through two self-adhesive, pre-gelled, low-impedance electrode defibrillator pads. The pads, cable, and connector are sold as disposable kits.

The MRL AED conforms to the AAMI DF39, *AHA Scientific Statement AED: Specifying and Reporting Arrhythmia Analysis Algorithm Performance*, and the IEC standard 601-2-04 for AEDs currently under development.

Features

The MRL AED is a self-contained, automatic external defibrillation device designed for use by trained personnel. Its features include:

- 3-step operation
- extensive voice and visual prompts for the operator
- continuous ECG, audio, and event recording for reporting each use to a printer or computer
- daily self-test to ensure readiness
- rechargeable battery
- monophasic or biphasic energy output
- lock-out protection to prevent inadvertent defibrillation

MRL AED Configurations

Three MRL AED configurations are available: Primary AED, Secondary AED, and Manual AED.

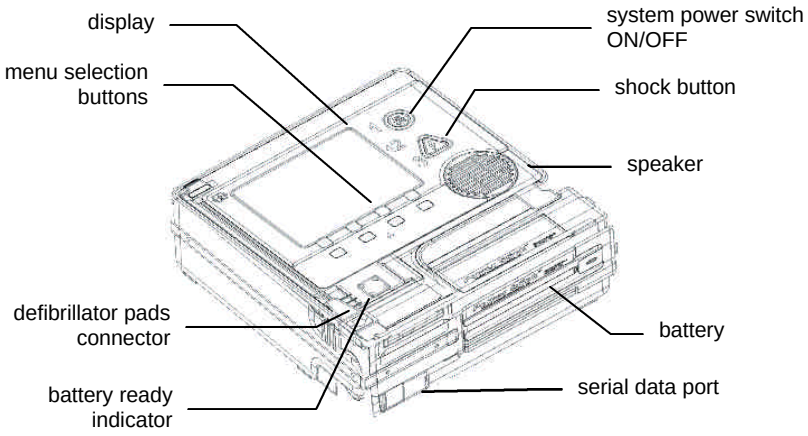
Primary AED	In this configuration, the unit provides automated text and voice prompts to guide the operator. It does not have an ECG tracing capability on the display.
Secondary AED	This configuration requires the optional ECG display upgrade. Automated Text and voice prompts are provided and a continuous ECG tracing displays on the LCD during operation.
Manual AED	This configuration requires the optional ECG display and Manual mode upgrades. This configuration includes automated text and voice prompts and an ECG tracing display. In addition, an authorized operator or supervisor with the proper pass code can manually override the automated operation of the AED. This allows the user to manually select energy settings and administer defibrillation shocks.

Functions

This section describes these MRL AED features:

- Controls
- Displays
- Text Prompts
- Voice Prompts
- Icons
- System Ready Indicator
- Serial Data Port
- Event Documentation

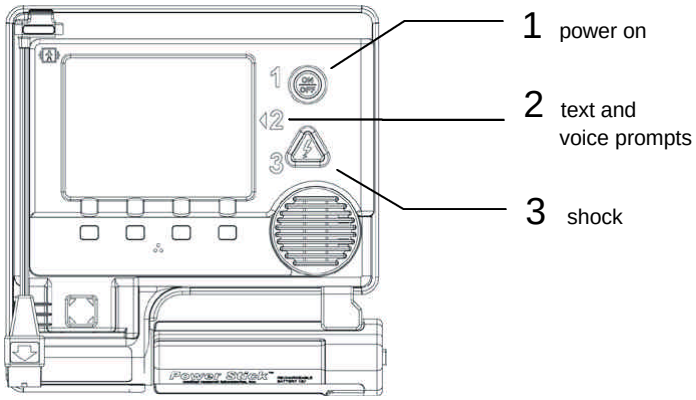
Detailed information on programming, using, and maintaining the MRL AED are presented in the *MRL LifeQuest AEDefibrillator Users Manual*.



Controls

The MRL AED is designed for ease of operation. After putting the defibrillator pads on the patient and connecting them to the MRL AED unit, the operator performs this simple three-step process:

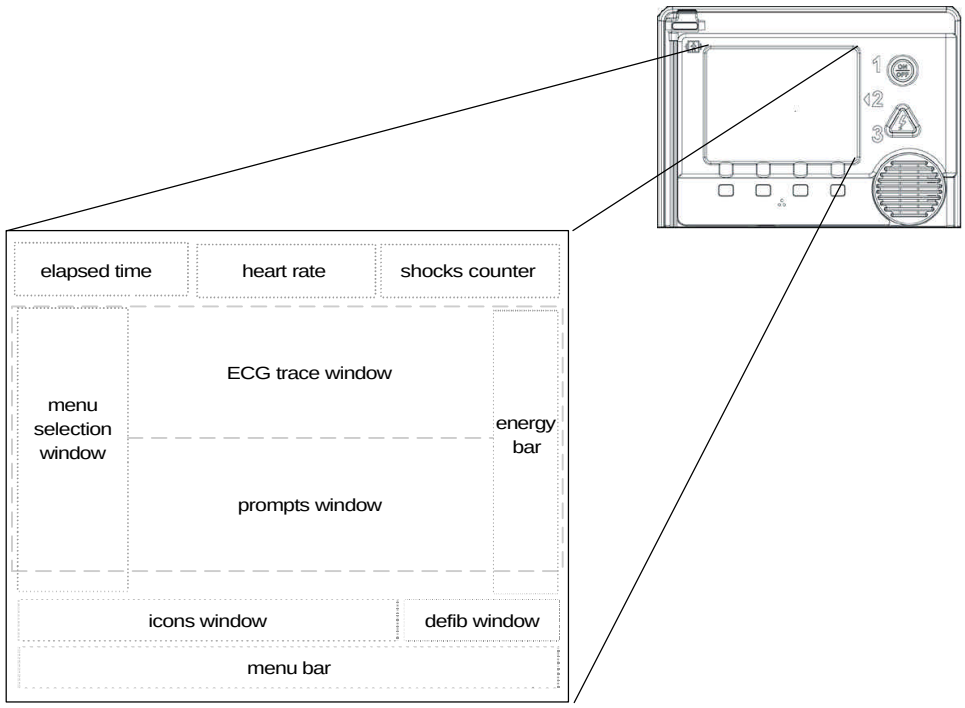
1. Turn the power ON.
2. Follow text prompts on the screen and voice prompts from the speaker.
3. If prompted, deliver shock by pressing the flashing red **Shock** button.



Power ON/OFF	Green ON/OFF button to toggle system power on/off
Shock	Red Shock button to discharge defibrillator; red LED flashes when defibrillator is fully charged
Menu Selection	Four soft buttons located in the case below the display; programmable functionality to make menu selections in manual mode

Display

Text prompts, patient data, and event information appear on the display screen. The screen is a VGA, monochrome liquid crystal display (LCD) measuring 320 x 240 pixels. The display is divided into ten functional areas. Operating information and user instructions display in these areas.



The ten functional areas on the display are:

Shocks Counter	Displays the number of shocks administered.
Defib Window	Displays the energy level selected or delivered. Also shows status messages.
ECG Trace (ECG add-on option)	Displays an ECG trace as a moving waveform (if this option is installed). If the defibrillation pads are not properly attached to the patient or connected to the unit, a dashed line is visible.
Prompts	Displays up to three lines of text (user instructions, directions for patient care, error messages).
Elapsed Time	Displays the time elapsed since the system was powered ON, or the time used on current patient. The time format is HH:MM:SS.
Energy Bar (Manual Mode only)	Highlights the selected energy level in a temporary window located to the right of the ECG Trace when the Charge button is pressed or a shock advised situation is detected.
Heart Rate (ECG or Manual Mode add-on option)	Displays a number representing the patient's heart rate (beats/minute). Dashed line displays when rate is out of range or when defib pad fault exists.
Icons Window	Displays operating status icons. See descriptions below.
Menu Bar	Displays four areas corresponding to the four buttons on the case below the LCD.
Menu Selection	Displays Manual Mode or Supervisor Mode menu choices. See the descriptions below.

If the optional ECG or manual mode upgrade is installed, an electrocardiogram trace is also displayed on a continuous basis. Graphical screen icons provide system operational information. The MRL AED operator or supervisor can use a simple menu-driven structure to set charge protocols and system configurations, set system operating parameters such as display contrast and volume, select one of 6 languages used for text and voice, and install upgrade options.

Text Prompts

Text prompts provide operating information, user instructions, and directions for patient care. The text prompts display in the lower half of the LCD above the icon window.

ANALYZING ECG	ECG leads are properly connected and the system is assessing the patient's heart rhythm.
ATTACH DEFIB PADS	Attach the defibrillation pads according to the instructions given on the package.
CHARGING	System is automatically charging the defibrillator to the energy level pre-set in the shock protocol.
CHECK PULSE	Check the patient's pulse.
IF NO PULSE - START CPR	Check the patient's pulse and begin a 60-second CPR cycle.
MOTION DETECTED	System has detected movement of the electrodes or the patient as indicated by inconsistent data readings.
NO SHOCK ADVISED	System has analyzed the patient's heart rhythm and determined that a shockable condition does not exist.
SHOCK ADVISED	System has analyzed the patient's heart rhythm and determined that a shockable condition exists.
SHOCK NOW	Prepare to administer the shock.
STAND CLEAR	Defibrillator is charged and ready for shock. Do not touch or move the patient.

Voice Prompts

The MRL AED voice prompt feature provides instructional prompts to guide the user through the defibrillation process without relying solely on text prompts.

The MRL AED provides audio instructions through the built-in speaker to provide operating instruction and assist the user during defibrillation. The voice prompts parallel the text and icon displays shown on the LCD.

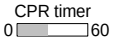
> *Voice prompts are displayed in brackets for the British model of the MRL AED when they differ from the current model.*

Analyzing heart rhythm. Do not touch the patient	Defibrillator pads properly attached and connected; accessing heart rhythm
Analyzing interrupted, motion detected	Patient or electrode moved
Check airway, check breathing, check pulse **[Check airway, check breathing, check circulation]**	Check patient's airway, breathing and pulse
Apply defib pads. Connect cable	Defibrillator pads are not properly attached to the patient or properly connected to the MRL AED
If no pulse, start CPR **[Begin CPR]**	Check the patient's pulse and begin 60-second CPR cycle
Low battery	Low battery charge; replace battery.
Memory Card full	Internal memory card full
No shock advised	Shockable condition does not exist
Shock advised	Shockable condition exists
Shock now, press the red button now	Push the red SHOCK button

Stand clear	Defibrillator is charged and ready for shock; do not touch or move the patient
Stop CPR	Stop CPR and wait for further instructions
It is safe to touch the patient	Defibrillator shock has been delivered

Icons

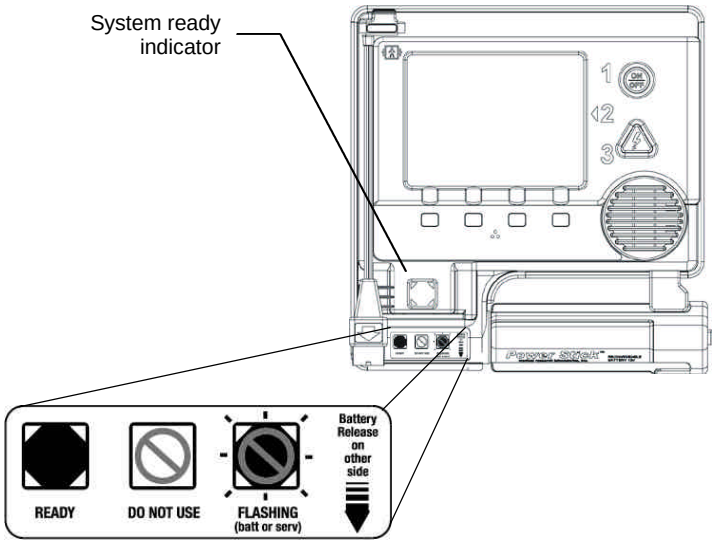
Icons provide operating status information. The icons display at the bottom of the LCD just above the menu bar.

	Auxiliary Power	Indicates the optional auxiliary power unit is plugged in. Icon displays and replaces the battery level indicator icon.
	Battery Level Indicator	Indicates the charge left in the battery is full.
	Battery Level Indicator	Indicates the charge left in the battery is partially depleted.
	Battery Level Indicator	Indicates the charge left in the battery is low.
	Battery Level Indicator	Indicates non-rechargeable, single use battery.
	Battery Level Indicator	Indicates rechargeable battery.
	Contrast	Indicates the level of contrast; levels are 1 through 9.
	CPR Timer	Represents a user adjustable second clock used to time CPR.
	Log Level	Indicates the amount of memory for entries remaining in the Log.
	Memory Card Level	Indicates the amount of memory for entries remaining in the optional Memory Card.

	Printer Status	Indicates log printing. Flashing icon indicates printer error.
	Volume	Indicates the speaker volume; 4 levels are indicated.
	Lock	Memory card locked.

System Ready Indicator

The battery ready indicator display, located on the lower left corner of the MRL AED, represents the operational readiness of the battery.



Ready	Battery is properly installed and charged. System is ready for use.
Do Not Use	System is NOT ready for use. Battery may not be properly installed or charge is too low for effective operation.
Flashing	Battery is low and requires charging.

Serial Data Port

The built-in Serial Data Port provides a direct connection to a computer or printer.

Event Documentation

The MRL AED stores event documentation including patient status, ECG traces, and treatment summary. The information is stored in an internal log or an optional PCMCIA external memory card. Event documentation is time stamped and can be downloaded to a printer or to a computer through the serial port on the MRL AED.

Battery Charging and Conditioning

This section provides procedures for charging and conditioning the NiMH PowerStick rechargeable battery. Do not attempt to recharge the non-rechargeable Lithium PowerStick battery.

Each new rechargeable NiMH battery is capable of 3 hours of monitoring or fifty 360J shocks. Each new Lithium battery is capable of 6 hours of monitoring or two hundred 360J shocks.

Battery maintenance is critical to ensuring that the MRL AED operates reliably. Periodically check the battery to ensure that the recommended replacement date has not elapsed. Over time and through use, the capacity of a battery will degrade. Properly maintaining a battery is crucial to maximizing the battery's capacity throughout its life. The amount of capacity degradation varies from battery to battery due to the conditions in which the batteries are used and maintained. An old PowerStick rechargeable battery should be replaced with a new one every 24 months.

A completely discharged battery will require approximately 1.5 to 2 hours to recharge. Charging time varies depending on battery capacity and state of charge. Deeply discharged batteries and those with higher capacity will take longer to charge. Partially discharged batteries and those with lower capacity will require less time to charge.

Installing the Battery

The MRL AED can use either a NiMH (Nickel Metal Hydride) PowerStick rechargeable battery or an extended-life Lithium PowerStick non-rechargeable battery.

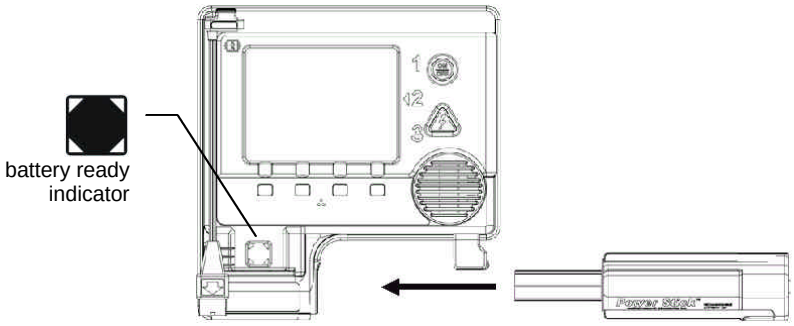
- Use the NiMH PowerStick rechargeable battery for applications involving frequent use.
- Use the Lithium PowerStick non-rechargeable battery for standby use.

The battery slides into the AED case and locks firmly in place. The battery forms the carrying handle of the MRL AED and therefore, you can always be sure that the battery is properly installed. If the battery is not fully charged, see the battery charging and conditioning procedures at the end of this chapter.

Using a non-rechargeable battery for training or testing will reduce the shelf-life and operating time of the battery.

To install the battery:

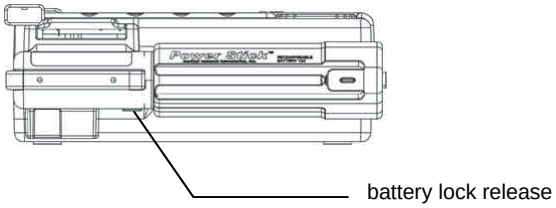
1. Align the thin, flat end of the battery with the opening in the lower front portion of the MRL AED case.
2. Push the battery in until it “clicks” and locks into place.



3. Make sure the battery ready indicator in the lower left of the display indicates that the battery has sufficient charge. If the status indicator displays anything other than the Battery Ready icon, the MRL AED is not ready for use.

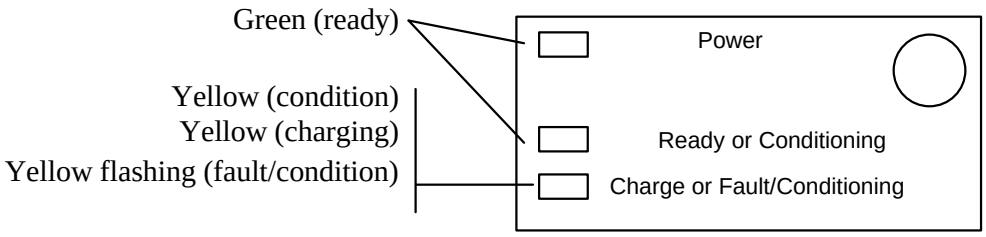
To release the battery:

1. Push the lock release on the bottom of the MRL AED case where the battery inserts into the unit.
2. Replace the battery with a backup. Recharge the removed battery: if it is a rechargeable battery.



MRL Quick Charger/Conditioner

The MRL Quick Charger/Conditioner is easy to use. The PowerStick is inserted directly into the charger. Status lights indicate the condition of the battery.



*A yellow flashing **Charge** light indicates either the PowerStick is defective or that a non-rechargeable battery has been inserted in the charger.*

Charging a Battery

To charge a battery using the MRL Quick Charger/Conditioner:

1. Insert the battery into the charger. When the battery is firmly seated, the yellow **Charge** light illuminates.
2. Monitor the charging light. Steady yellow means charging. Flashing yellow means that the battery is not charging due to a **Fault** condition. This will occur if the battery is either defective or the wrong type (non-rechargeable).
3. The **Charge** light turns off and the green **Ready** light turns on when the battery is fully charged.

Charging battery at temperatures above 30ºC (86ºF) increases the charging time and may result in a gradual decline in battery capacity.

If a fully charged battery is inserted into the charger, it will be charged for a short period of time while the charger determines its state of charge. When it is determined that the battery is fully charged, the yellow light will begin to flash. This process may take several minutes.

When removing a battery from the charger, always allow at least 3-5 seconds for the system to reset prior to inserting another battery.

Conditioning a Battery

The effective life of the NiMH PowerStick battery can be prolonged by periodic conditioning.

To initiate a battery conditioning cycle:

1. Insert the battery into the charger.
2. Press the conditioning button on the charger control panel. The yellow ready-conditioning light illuminates solid and the yellow charge/fault/conditioning flashes.

   At the end of the conditioning, the charger automatically begins a normal charge cycle.

3. Monitor the charging light. The **Charge** light turns off and the green **Ready** light turns on when the battery is fully charged.

Preparing the MRL AED for Storage

After each use, any event documentation should be retrieved from the internal log or external memory card and printed. Any error messages or malfunctions should be reported and corrective actions taken before storing the unit for reuse. Then, the MRL AED should be inspected, cleaned, and a new supply of electrode pads restocked to prepare the unit for its next use.

During storage, the MRL AED performs periodic self-tests including the functionality of the unit and the status of the battery and internal circuitry. A more detailed test of the unit's operation and battery status should be performed on a regular basis. See the *MRL LifeQuest AEDefibrillator Users Manual*, Chapter 4 *Maintaining the MRL AED* for more information.

Chapter 2

MRL AED Part Numbering

MRL LifeQuest AEDefibrillator Service Manual

This chapter presents the AED part numbering system, lists the options and accessories available for the MRL AED, and provides technical specifications for the MRL AED system.

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AED Part Numbering System

MRL uses a part numbering system that allows both the user and service technician to understand what type of unit and installed options are in each MRL AED system.

9 7 0 2 0 0 _____ _____ _____ ____

Biphasic ECG/Man Review Lang.

Biphasic:

B = Biphasic Defibrillator (970204)

ECG/Man:

E = ECG Display in AED mode (970201)
M = Manual Mode and ECG Display (970202)

Review:

R = On Screen Log Review (970203)

Lang:

E = English
U = UK
S = Spanish
G = German
F = French
I = Italian
P = Portuguese

Note: Batteries, charger, and carrying case are ordered as separate line items.

List of Options and Accessories

System Upgrades and Options

The MRL AED is an automatic defibrillator designed for easy operation. It is designed so that optional features can be added as simple software upgrades.

Display options include providing an ECG trace in automatic mode, showing a biphasic defibrillation waveform, and on-screen log data review. Another option allows the unit to be switched from automatic mode to manual mode. Manual mode allows qualified users to set the defibrillation energy level, charge the unit, and deliver a shock.

MRL AED Accessories Parts List

MRL AED

970200	MRL AED with two defibrillation pads, operations manual, Software Biphasic activation
970204	Biphasic

MRL AED Options

970201	ECG Display
970202	Manual Override with ECG Display (970201)
970203	Log Review

MRL AED Accessories

001829	MRL Power Stick - Rechargeable battery
001830	MRL Power Stick - Non-rechargeable battery
981113	Battery Charger (to be used with 001829)
900216	MRL AED Carrying Case
001788	Multipurpose Defibrillation Pads (10 pair / box)
002119	MRL AED Parallel Communications Kit
002120	MRL AED PC Data Transfer / Serial Comm Kit
980136	MRL Cardiolog Datacard - 4 MB
980143	MRL AED Trainer
001910	MRL Smartview Software Review Program
980139	MRL Patient Simulator
900165	Data Printer

Technical Specifications

Physical

Category	Specification
Dimensions	9 3/8" x 9" x 3" (238 x 229 x 76 mm)
Weight	Less than 5 pounds (2.3 kg)
Operating Temperature	32° to 122°F (0° to 50°C)
Storage Temperature (without battery)	-22° to 150°F (-30° to 65°C)
Humidity	Up to 95% or 10° to 95°C (non-condensing)
Altitude	-500 to 15,000 feet (-150 to 4570 m)
Shock	Mil Std 810E method 516.4, procedure 1 (40G, 6-9ms pulse, 1/2 sine each axis)
Vibration	Mil Std 810E method 514.4, category 10
Water resistance	IEC 529 IPX4

Data Management

Category	Specification
Event Documentation	Internal and via MRL Datacard
Internal Memory Capacity	1MB:100 4-sec ECG samples or 300 time stamped events
Datacard Capacity	4MB - 90 min of Continuous ECG 40 min of ECG and audio 8MB - 3 hrs of Continuous ECG 80 min of ECG and audio 16MB - 6 hrs of Continuous ECG 2.5 hrs of ECG and audio
Playback	MRL PIC or Smartview
Quick Report	Treatment Summary, Event Log, Test Log
Datacard Compatibility	Compatible with MRL PIC advance Life Support defibrillator
Communication	Serial port via RS-232 to PC and Printer

Defibrillator

Category	Specification
Output	AAMI-Monophasic Truncated exp. 65
Energy Sequence	200, 200,360 or 200, 300, 360J (user configurable)
Manual Energy Selection	2,3,5,10,20,30,50,70,100,150,200,300,360J
Auto Energy Selection	2,3,5,10,20,30,50,70,100,150,200,300,360J
Manual Lockout	Via Pass code
Charge Time	Less than 15 sec.
Analysis Time	8-12 sec.
Audible Prompts	13 audible prompts
Visual Prompts	13 test screen prompts
Controls	Two buttons-On/Off, Discharge 4 software configurable buttons
Waveform Details	Peak current (I_p) and duration (t) at 360 Joules delivered energy (The values shown are within 10%) Load (Ohms) I_p (Amps) t (ms) 25 53.1 10.0 50 27.1 18.8 100 13.7 36.4

Display

Category	Specification
Type	¼ VGA LCD
Size	5.7" (145 mm) Diagonal
Resolution	320x240
Freq Response	0.5 to 40 Hz
Heart Rate	20 to 300 BPM, user configurable displayed
ECG Input	Via defib pads, isolated, Type BF, defibrillator-proof
Low Battery Indicator	Battery Icon gauge on display with 4 capacity level indicators

Battery

Category	Specification
Rechargeable	NiMH 12V, 2.1Ah
Capacity	50 full energy discharges or 4 hours ECG monitoring
Charge Time	1.5 to 2 hours
Non-Rechargeable	Lithium Ion 12V, 5.2 Ah
Capacity	75 shocks or 8 hours ECG monitoring with Integral Backup
Shelf Life (25°C±15°C)	10 years Shelf Life 5 years standby

Rhythm Recognition Performance

The MRL AED algorithm exceeds the requirements of ANSI/AAMI DF39-1993 section 3.3.18 and the sensitivity and specificity levels recommended by the AHA *Automatic External defibrillators for Public Access Use: Recommendations for Specifying and Reporting Arrhythmia Analysis Algorithm Performance*. The test database includes shockable rhythms consisting of ventricular fibrillation rhythms (>150uV) and wide-complex ventricular tachycardia at a rate greater than 160 BPM. Non-shockable rhythms include various sinus rhythms including supraventricular tachycardia, atrial fibrillation, atrial flutter, sinus rhythm with PVC's, asystole, pacemaker rhythms, and ventricular tachycardia with a rate less than 160 BPM and/or narrow complexes.

Rhythm Recognition Test Results

Specificity (non-shockable)
Exceeds AAMI Requirement: >95% and AHA recommendation: >99%

Sensitivity (VFIB)
Exceeds AAMI Requirement and AHA recommendation: >90%

Sensitivity (VTACH)
Exceeds AAMI Requirement and AHA recommendation: >75%

Chapter 3

MRL AED Setup

MRL LifeQuest AEDefibrillator Service Manual

This chapter explains how to set the basic system operating options through the User Menu (Automatic or Manual Mode). It also provides information on accessing and setting the advanced system operating options using the Supervisor Menu.

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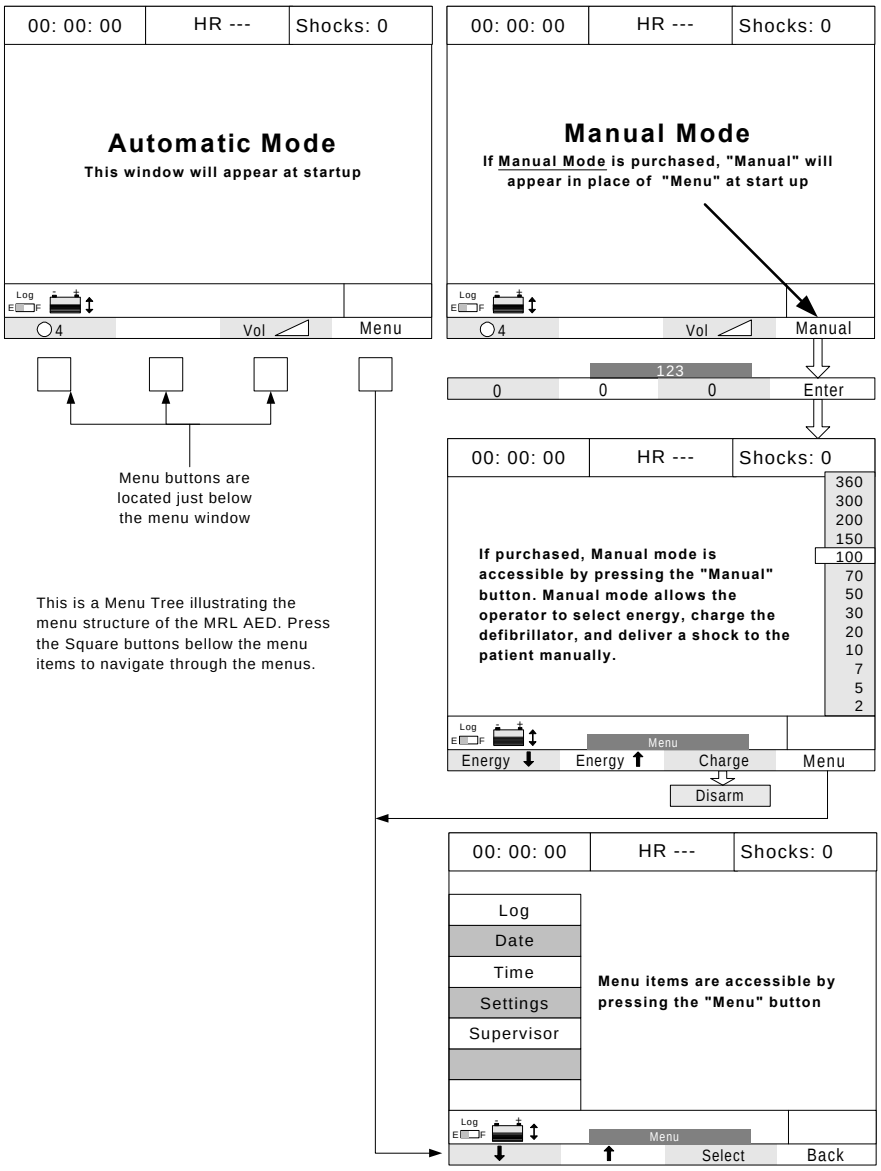
User Menu Structure Overview

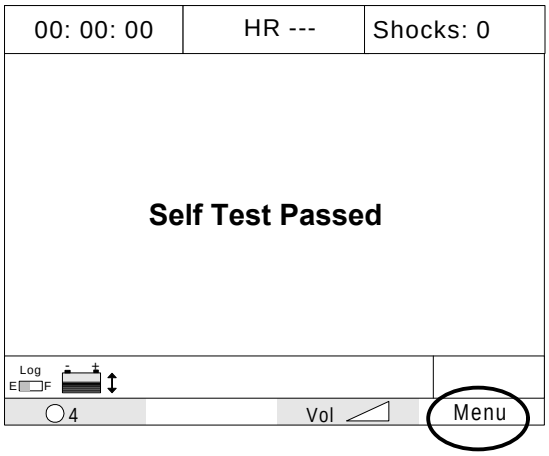


The operating options are available to the operator through a simple menu structure. The basic system operating options are accessed through the User Menu in either Automatic or Manual Mode. The advanced system operating options are accessed through the Supervisor Menu.

Accessing the User Menu from Automatic Mode

When the MRL AED is powered-up, the unit performs a self-test and the start-up screen displays.

Access the User Menu by pressing “Menu” in the lower right corner.

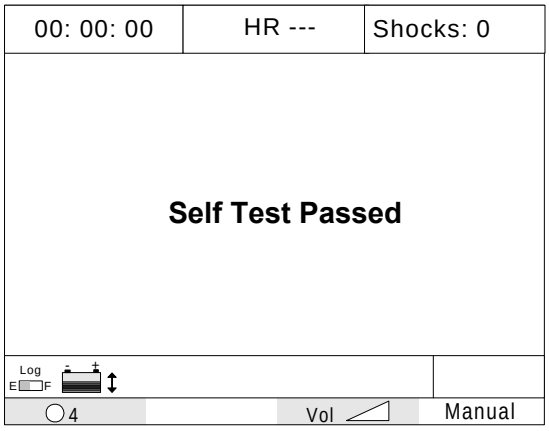


If the Manual Mode is purchased, MANUAL appears in place of MENU on start-up screen.

Accessing the User Menu from Manual Mode

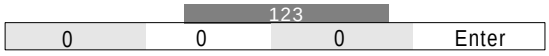
Only available on units with Manual Mode purchased.

When the MRL AED is powered-up with the Manual Mode option installed, the unit performs a self test and the manual mode start-up screen displays.



To access the Manual Mode Menu:

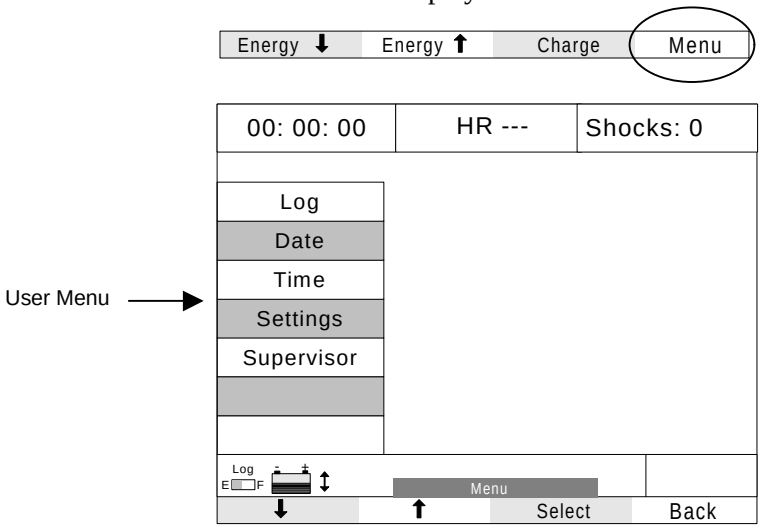
1. Press **Manual** to display the manual mode passcode screen.



2. Press the button below the corresponding number to select that digit of the manual mode passcode.
3. Repeat Step 2 for each digit of the passcode until the correct number displays.

The default password is 123.

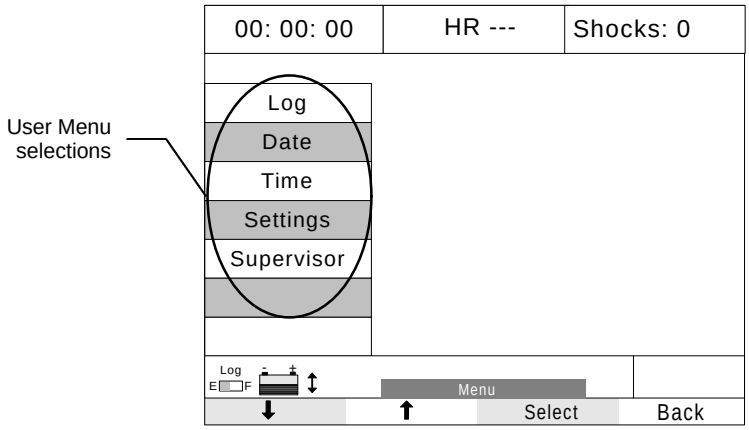
4. Press **Enter** to accept the passcode. If the number is correct, the AED enters manual mode.
5. Press **Menu** to display the User Menu screen.



*Press **Back** to return to the manual mode operating screen.*

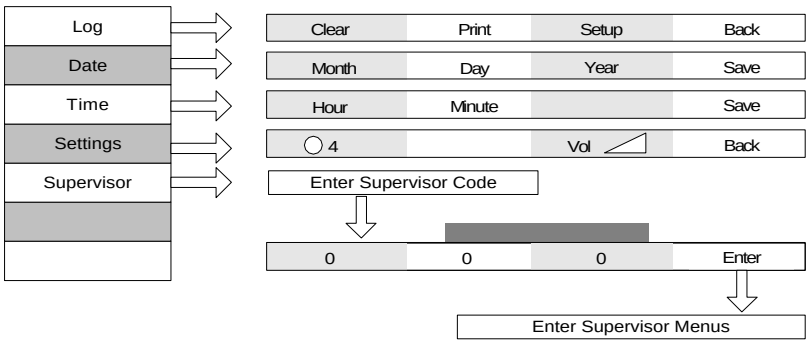
User Menu

Use the two arrow buttons on the bottom menu to move from one menu selection to the next. The selected menu item is highlighted by a dark box. Push the **Select** button to select the highlighted menu item.



Log	Allows viewing, hearing, pointing or transferring the internal log.
Date	Display the current date, and set and save a new date (month, day, year) using the buttons below the Menu Bar.
Time	Display the current time, set and save a new time (hour, minute) using the buttons below the Menu Bar.
Settings	Adjust the LCD contrast and adjust the volume of the system audio and save the settings.
Supervisor	Enter the password code using the buttons below the Menu Bar to display the Supervisor Menu selections.

For each menu item selected, the corresponding option appears at the bottom of the display. If Supervisor is selected, the user must enter the correct supervisor passcode in order to enter the Supervisor Menu selection screen.

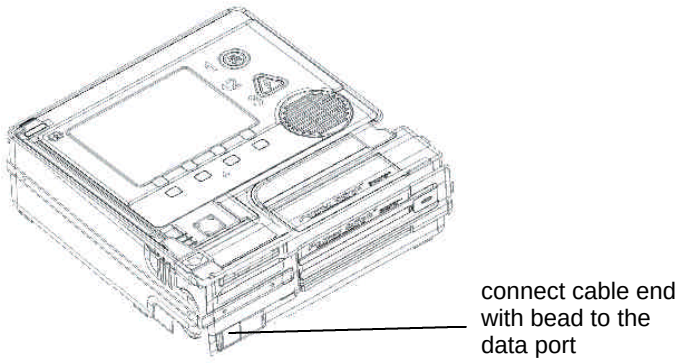


The subsections that follow explain how to set the options available through the User Menu. The procedures included are:

- Working with the log
- Setting the date
- Setting the time
- Adjusting contrast
- Adjusting the speaker volume

Working with the Log

The log contains a record of ECG tracings and time-stamped system status events. The log can be printed to a parallel printer, printed to a serial printer, or transferred to a PC for viewing. Use the appropriate setup procedure to connect the printer or PC to the MRL AED, then follow the instructions for printing.



To setup a parallel printer:

The MRL AED Parallel Communication Kit (002119) is required for this connection.

1. Connect the Serial to Parallel Cable (550786) in to the MRL AED serial data port and into the Convert-A-Port (900412A).
2. Connect the Convert-A-Port to the parallel printer port on your printer.
3. Make sure the Convert-A-Port dip switches are set to 57600 baud. See the instructions included with the communication kit for details.

To setup a serial printer:

The MRL AED PC Data Transfer/Serial Communication Kit (002120) is required for this connection.

1. Connect the Serial Communication Cable (551778) into the MRL AED serial data port and the other end to the Serial Printer Transfer Adapter (520469).
2. Connect the Serial Printer Transfer Adapter to the serial printer.

To setup a PC for viewing:

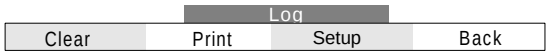
The MRL AED PC Data Transfer/Serial Communication Kit (002120) is required for this connection.

1. Connect the Serial Communication Cable (551778) into the MRL AED serial data port and the other end into the PC Data Transfer Adapter (520468).
2. Connect the PC Data Transfer Adapter to the 9-pin serial port on your PC.
3. Use the Terminal or Serial Communications program on the PC to set the port settings to 57600 baud, N, 8, 1.

When the printer or PC is properly setup, turn on the output device and the MRL AED. Use the following procedure to print the log.

To print the log:

1. Access the User Menu. Select **Log** to display the Log menu bar.



2. Press **Setup** to display the Output Mode menu bar.
3. Select **Text** or **ECG** and 57600 Baud**.** Press **Back** to return to the Log menu bar.
4. Press **Print** to print the log entries. A steady printer icon replaces the log icon to confirm printing.

A flashing printer icon indicates an error. Verify that the cable and adapter are connected correctly and check that the printer is online and has paper.

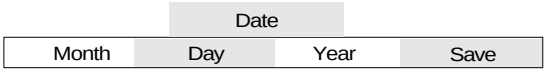
5. Press **Clear** to remove all log entries.
6. Press **Back** to return to the Main Menu.

Setting the Date

Use the date screen to change the date. Use the menu selection buttons below the menu bar to change the date displayed.

To set a new date:

1. Access the User Menu. Select **Date** and display the Date menu bar.



2. Press the buttons below the month, date, and year to change the date displayed.
3. Press **Save** to enter the date displayed and return to the User Menu.

Setting the date will force a new patient into the entry log.

Setting the Time

The MRL AED time-stamps are events saved to the log. A 24-clock is used for time displays (e.g., 14:24 is used for 2:24 p.m.). Use the time screen and the menu selection buttons below the menu bar to change the time displayed.

To set a new time:

1. Access the User Menu. Select **Time** to display the Time menu bar.

2. Press the buttons below the hour and minute to change the time displayed.
3. Press **Save** to enter the time displayed and return to the User Menu.

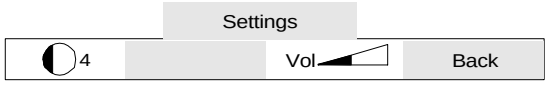
Setting the time will force a new patient into the entry log.

Adjusting the Contrast

The contrast of the MRL AED liquid crystal display can be adjusted. There are nine pre-set contrast levels available. Use the contrast screen and the menu selection button below the menu bar to change the contrast of the LCD.

To adjust the LCD contrast:

1. Access the User Menu. Select **Settings** to display the Settings screen and menu bar.



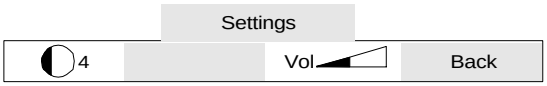
2. Press the contrast button (◐) to change the contrast of the LCD. The number next to the contrast icon changes corresponding to increases in the contrast (1-9).
3. Press **Back** to return to the User Menu.

Adjusting the Speaker Volume

The volume of the voice prompts through the MRL AED speaker can be adjusted. There are four pre-set volume levels available. Use the volume screen and the menu selection button below the menu bar to change the volume of the voice prompts.

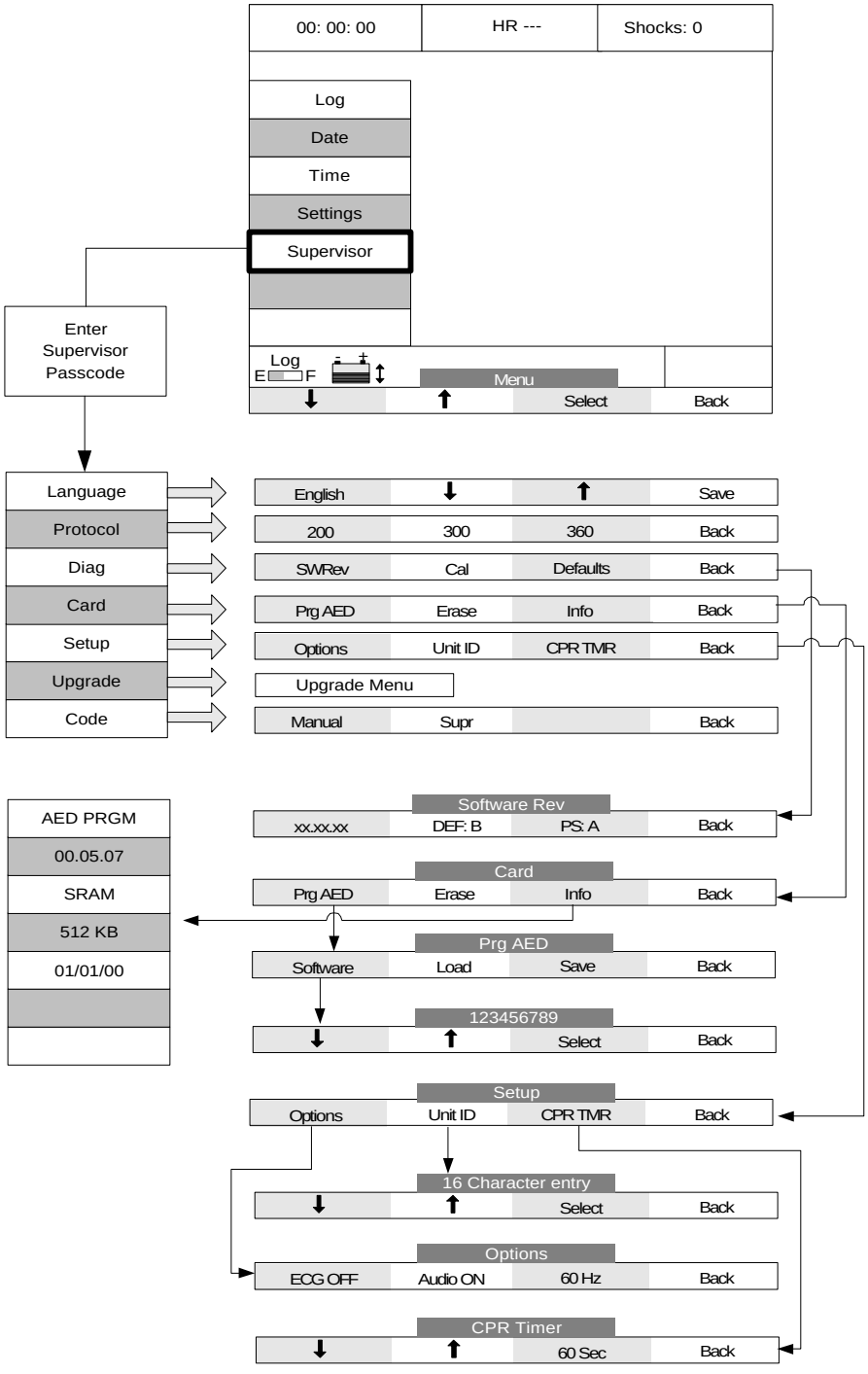
To adjust the volume:

1. Access the User Menu. Select **Settings** to display the Settings screen and menu bar.



2. Press **Volume** ( ) to change the volume of the voice prompts through the MRL AED speaker. The indicator in the volume icon changes to one of four positions.
3. Press **Back** to return to the User Menu.

Supervisor Menu Structure



Supervisor Menu

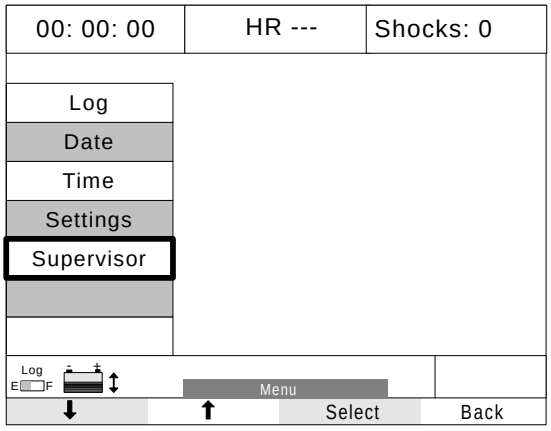
The subsections that follow explain how to access the Supervisor Mode Menu and set the options available through that menu.

Accessing the Supervisor Menu

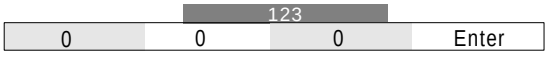
The Supervisor Menu is accessed from the User Menu screen.

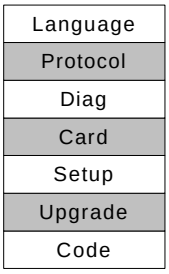
To access the Supervisor Menu:

1. First, go to the User Menu as described earlier in this chapter.
2. Use the up and down arrows to choose **Supervisor,** and press select.



3. Enter the passcode and press enter. If passcode is correct, the Supervisor menu will appear.





Use the two arrow buttons on the bottom menu to move from one menu selection to the next. The selected menu item is highlighted by a dark box. Push the Select button to select the highlighted menu item.

Language	Select text and audio language using the buttons below the Menu Bar. Language choices are English, French, German, Portuguese, Italian, and Spanish. (Restart the MRL AED to activate the language selected.)
Protocol	Select the energy level protocol using the buttons below the Menu Bar. Standard (default) protocol is 200J, 300J, and 360J.
Diag	View software revisions/ reset factor defaults.
Card	Access PCMCIA card functions.
Setup	Enable or disable the ECG trace and audio recording 50/60 Hz. Set unit ID and set time for the CPR timer.
Upgrade	Add upgrade options to the system.
Code	Set both the Manual Mode and the Supervisor Mode pass code numbers using the buttons below the Menu Bar.

The procedures follow for:

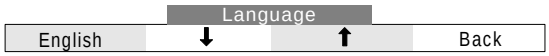
- Selecting a language
- Setting the charge protocol
- Viewing software revisions
- Restoring factory defaults
- Viewing information on a PCMCIA memory card
- Working with memory cards
- Enabling/disabling ECG and audio setting options
- Changing manual/supervisor passcodes
- Upgrading the MRL AED system

Selecting a Language

The language used for text on icons, screen displays, and prompts and used for voice prompts can be changed if the MRL AED has the language option upgrade installed. The language choices available are English, French, German, Portuguese, Italian, and Spanish.

To select a different language:

1. Access the Supervisor Menu. Select **Language** and display the Language screen and menu bar.



2. Press the buttons below the arrows to change the language.
3. Press **Back** to select the language displayed and return to the Supervisor Menu.
4. Restart the MRL AED to activate the language selected and change the screen text and voice prompts.

Setting the Charge Protocol

The standard MRL AED charge protocol provides a sequence of three defibrillator shocks. The default protocol setting is 200 Joules, 300 Joules, and 360 Joules. Use the menu selection button below the menu bar to change the shock charge displayed.

To set a new shock charge:

1. Access the Supervisor Menu. Select **Protocol** and display the protocol menu bar.

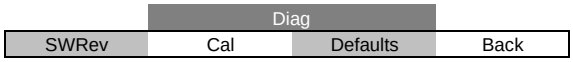
2. Press button below the digit to toggle the values.
3. Press **Save** to enter the charge displayed and return to the Supervisor Menu.

Diagnostics

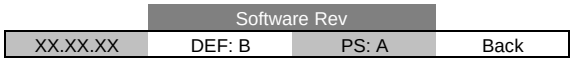
Use the diagnostics screen to view the installed versions of the software and restore factory defaults.

To view software revisions:

1. Access the Supervisor Menu. Select **Diag** to display the Diagnostics screen and menu bar.



2. Press **SWRev** to display the revisions of the current software for the motherboard xx.xx.xx, defibrillator DEF: and the preamplifier PS:.

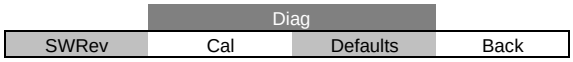


3. Press **Back** to return to the Diag menu. Press **Back** again to return to the Supervisor Menu.

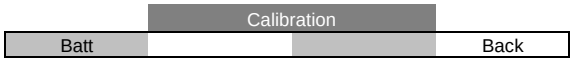
To calibrate the battery voltage:

The unit must be powered by a calibrated auxiliary source to calibrate the battery voltage.

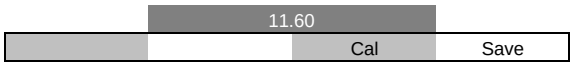
1. Access the Supervisor Menu. Select **Diag** to display the Diagnostics Menu.



2. Select **Cal** to display the Calibration Menu.



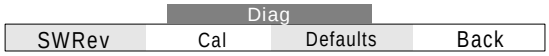
3. Select **Batt** to display the Battery Voltage calibration menu.



4. Set input auxiliary voltage to 11.60 Volts.
5. Press **Cal** to calibrate the voltage setting or press the buttons below the up and down arrows to manually set the voltage. The number in the menu title bar will change with different voltage settings.
6. Press **Save** to exit the Battery Calibration Menu.

To restore factory defaults:

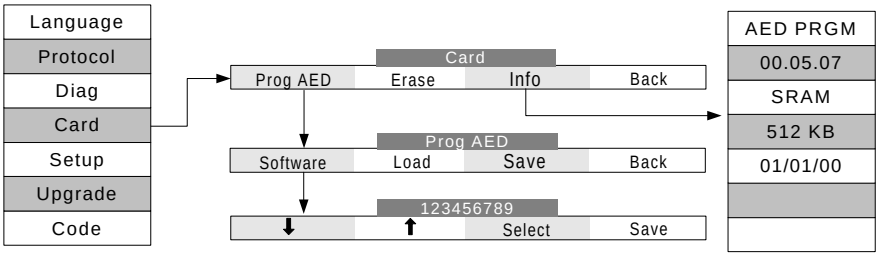
1. Access the Supervisor Menu. Select **Diag** to display the Diagnostics Menu.



2. Press **Defaults** to return the user selected settings to the factory defaults.
3. Press **Back** to return to the Supervisor Menu.

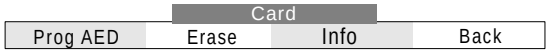
Viewing Information on the PCMCIA Memory Card

The MRL AED has an internal memory capable of recording and outputting event documentation to a printer. Additional memory storage is available using a removable PCMCIA memory storage card. Use the card screen and the menu selection button below the menu bar to erase the external memory card (erase card prior to first use to format the card), program the unit for software upgrades.



To view information on the PCMCIA memory card:

1. Access the Supervisor Menu screen. Select **Card** to display the Card menu bar.



2. Press **Info** to view the size, type, contents, and format date.
3. Press **Back** to return to the Supervisor Mode Menu.

To Program the AED from a Memory Card:

1. Access the Supervisor Menu screen. Select **Card** to display the Card Menu bar.
2. Insert a program card into the memory card slot.
3. Press **ProgAED** to access the ProgAED Menu.
4. Select **Software**.
5. Enter the Reprogram code and press **Save**. The unit will reprogram and reboot with new software.

To Format a Memory Card:

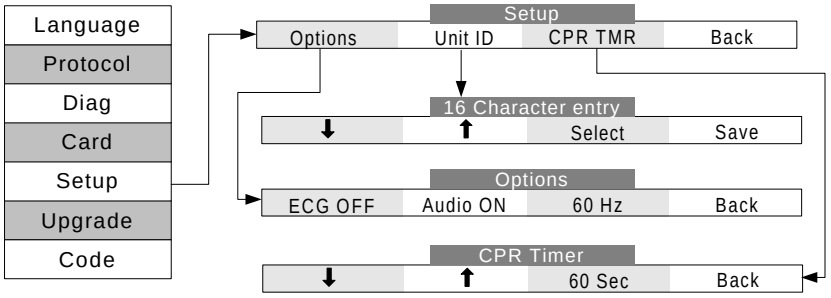
1. Access the Supervisor Menu screen. Select **Card** to display the Card Menu bar.
2. Insert a memory card, with write protect off, into the memory card slot.
3. Press **Erase.**
4. The Unit will format the memory card.

The card must be reinserted to begin collecting data after formatting.

Setting Options

Use the Setup screen to access system options and parameters. From this screen:

- Enable or disable the ECG trace, audio prompts, and adjust the notch filter
- Assign a unit ID number to this MRL AED unit for the log record
- Adjust the CPR timer



To enable/disable Options (ECG trace, audio, notch filter):

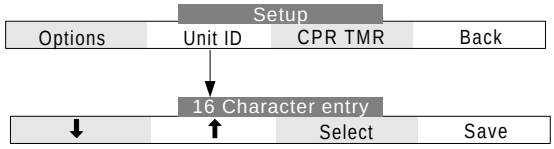
1. Access the Supervisor Menu screen. Select **Setup** to display the setup menu bar.
2. Press **Options** to display the options menu bar.
3. Press **ECG** to toggle between ECG trace ON and ECG trace OFF.

This option only appears when ECG tracing has been purchased.

4. Press **Audio** to toggle between Audio Recording ON and Audio Recording OFF.
5. Press notch filter to toggle between 50Hz and 60Hz.
6. Press **Back** to return to the Setup screen.

To set Unit ID:

1. Access the Supervisor Menu screen. Select **Setup** to display the setup menu bar.
2. Press **Unit ID** to display the Unit ID menu bar.



3. Press the up/down arrows to enter the code numbers of the Unit ID.

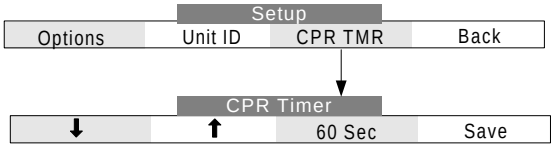
There are 16 available characters for the Unit ID.

4. Press **Save** to save the number and return to the Setup screen.

To set CPR Timer:

1. Access the Supervisor Menu screen. Select **Setup** to display the Options setup screen and menu bar.

2. Press **CPR Timer** to display the CPR Timer screen and menu bar.



3. Press the up/down arrows to change the time displayed for the CPR Timer.

Values available are between 15 and 90 seconds.

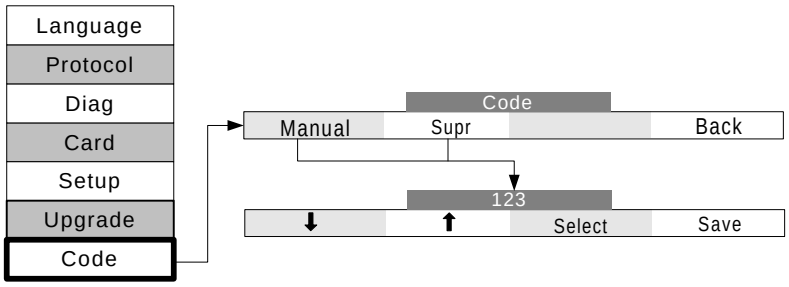
4. Press **Save** to accept the time set and return to the Setup screen.

Changing Manual and Supervisor Passcodes

Access to the manual mode and the manual/supervisor menus are protected by passcodes. The supervisor can change the passcodes. Use the code screen and the menu selection buttons below the menu bar to change the manual mode and supervisor mode passcodes.

To change a passcode:

1. Access the Supervisor Menu. Select **Code** to display the Code setup menu bar.
2. Press either Manual or Supr to set code.



3. Press the up/down arrows to move to select the new passcode number.
4. Press Save to accept the new passcode and return to the Code Menu.

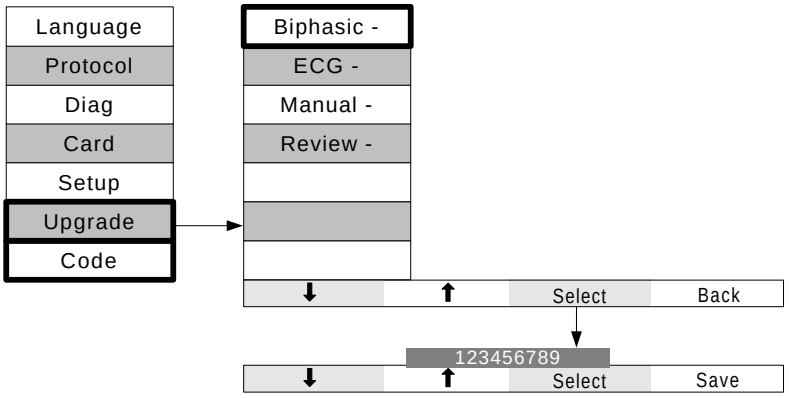
Upgrading the MRL AED System

Upgrade options are currently available and new options available in the future can be added to the MRL AED system. Updating the software can be performed through the memory card port. Use the upgrade screen and the menu selection buttons below the menu bar to add or change the features of the MRL AED.

To upgrade the MRL AED:

1. Access the Supervisor Menu screen. Select **Upgrade** and display the Upgrade screen and menu bar.

A plus (+) displays if an option is currently installed and a minus (-) displays if the option is not installed.



2. Choose the option to purchase, and press select.

Each upgrade purchased has a unique upgrade password code that must be entered before the upgrade can be installed on the MRL AED.

3. Press the up/down arrows to select each the upgrade passcode digit.
4. Press **Select** to accept the digit entered.
5. Repeat steps 3 – 4 for each passcode digit.
6. Press **Save** to accept the new passcode.
7. Restart the unit to enable/disable the option.

Chapter 4

Performance Test Procedures

MRL LifeQuest AEDefibrillator Service Manual

The following inspections and performance test should be performed by qualified biomedical personnel at regularly scheduled intervals. Factors such as the frequency of equipment use or operational policy may dictate that these procedures be performed as often as every 90 or 180 days. In any case, the maximum interval should not exceed one year, for non PAD applications.

Inspection Procedures **4-2**

Recommended Test Equipment **4-3**

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Defibrillation Tester 4-3
Stop Watch....4-3
Electrical Safety Analyzer....4-3

Safety Testing **4-4**

ECG Monitor **4-5**

Sweep Speed **4-6**

Heart Rate Display Accuracy **4-7**

Defibrillator Energy Accuracy **4-8**

Defibrillator Charge Time **4-9**

Inspection Procedures

1. Inspect Unit for Wear
    a. Inspect the outer enclosure and display panel for cracks, chipping, or other obvious damage.
    b. Clean away any foreign materials.
2. Inspect Pad Adapter Cable
    a. Inspect the adapter for any signs of wear or damage, such as cuts or cracks in cable insulation, bending or corroding of connector pins.
    b. Replace a damaged pad adapter prior to returning the MRL AED to use.
3. Inspect Power Cables on the Battery Charger (if applicable)
    a. Inspect the main (line) power cord and the transformer to charger cable for damage.
    b. Check the cord for cuts or cracks in the insulation and strain reliefs.
    c. Inspect the connector for bending that could indicate abuse.
    d. Replace a damaged power cord or transformer to charger cable prior to returning the MRL AED to use.

Recommended Test Equipment

The following test equipment devices are recommended for servicing the MRL AED:

- ECG Simulator
- Defibrillation Tester
- Stop Watch
- Electrical Safety Analyzer

ECG Simulator

The ECG simulator should be capable of:

- Providing a Normal Sinus Rhythm waveform with selectable rates from 30 to 300 BPM and amplitudes from 0.5 to 2.0 mV.
- Displaying a sine wave with selectable frequencies from 2 to 20 Hz.

The Simulator must have selectable arrhythmias which includes Ventricular Fibrillation.

Defibrillation Tester

The Defibrillation Tester should be capable of accurately measuring the MRL AEDefibrillator outputs that are trapezoidal (truncated exponential) in waveform shape or Biphasic (if purchased). Energy measurement range shall be between 1 Joule and 360 Joules. The Tester must have a standard 50 ohm, non-Inductive test load. The tester should also provide a Ventricular Fibrillation waveform output on the pad / sense conductors.

Stop Watch

Required when timing the defibrillation charge time, resolution to the nearest second is required.

Electrical Safety Analyzer

Requires standard test load compliant with either AAMI ESI or EN 60601-1. Measurement of leakage current from 1 - 300 µA.

Safety Testing

Equipment Required

Electrical Safety Analyzer

Procedure

The MRL AED has been designed and manufactured to comply with the requirements of Class I equipment, as defined by EN 60601-1 and applicable particular standards regarding electrical safety. Many of these requirements involve conditions that are impractical or potentially damaging and are therefore not intended for routine testing.

Those tests recommended for routine safety checks can be readily performed with any of a number of commercially available safety analyzers. This equipment provides a safe and convenient method of verifying the integrity of the protection against electric shock, employed by the MRL AED.

Typically, this equipment can perform the following tests. The test should be performed according to the operating instructions pertaining to the safety analyzer in use.

* Patient Source Leakage - between the patient lead contacts.

Electrical safety checks can be performed at intervals established by user preference. The maximum length of time between checks should not exceed one year.

Acceptable Results

Patient source Leakage current must not exceed 10 μA.

Corrective Action

Remove from service until any unacceptable result is corrected. Possible causes of excessive leakage currents are usually related to damaged insulation.

ECG Monitor

Requires ECG Option to be purchased and activated from the Supervisor Menu. Refer to the Users Guide to activate ECG Display.

Equipment Required

ECG Simulator with calibrated 1 mV output

Procedure

1. Connect the ECG Simulator to the Pad cable.
2. Set the ECG Simulator for a 2 Hz sinusoidal output at 1 mV peak to peak.
3. Turn on the MRL AED, ensure ECG display has been activated.
4. Record the cycles of the test signal.
5. Repeat steps 1 through 4 with the simulator's frequency set to 20 Hz.

Acceptable Results

The amplitude of the recorded test signals, in steps 4 and 5, must be at least 7 +/- 0.5 mm.

This measurement is made from peak-to-peak.

Corrective Action

If measured bandwidth is unacceptable, verify that the simulator's output is constant over the frequency range. Frequency response is determined by fixed component values (and is not adjustable in the MRL AED).

Contact an authorized MRL service center for assistance.

Sweep Speed

Requires ECG Option to be purchased and activated from the Supervisor Menu. Refer to the Users Guide to activate ECG Display.

Equipment Required

ECG Simulator with calibrated output rates

Procedure

1. Connect the ECG Simulator to the Pad cable.
2. Set the ECG Simulator for Normal Sinus Rhythm at a rate of 60 BPM and an amplitude of 1 mV.
3. Turn on the MRL AED, ensure ECG display has been activated.
4. Measure the distance between R-wave peaks on the monitor.

Acceptable Results

The distance between R-wave peaks should be 22.5 mm +/- 2.5 mm.

Corrective Action

Verify accurate simulator rate.

Contact an authorized MRL service center for assistance.

Heart Rate Display Accuracy

Requires ECG Option to be purchased and activated from the Supervisor Menu. Refer to the Users Guide to activate ECG Display.

Equipment Required

ECG Simulator with calibrated adjustable output rates

Procedure

1. Connect the ECG Simulator to the Pad cable.
2. Set the ECG Simulator for Normal Sinus Rhythm. Set simulator output for 1 mV and a rate that falls within the range of 20 to 300 BPM.
3. Turn on the MRL AED and ensure ECG display has been activated.
4. Allow rate meter to stabilize approximately 45 seconds then note reading.
5. Select several other rates within the 20 - 300 BPM range. Allow the rate meter to stabilize for 45 seconds after each rate change, then record the rate.

Acceptable Results

For each heart rate checked, heart rate shall differ by not more than 5 % from selected rate.

Corrective Action

Verify the simulator rate setting is accurate. Confirm the ECG waveform is free from artifact.

Contact an authorized MRL service center for assistance.

Defibrillator Energy Accuracy

Caution

Lethal voltages can be present inside the AED and at the AED Pads and cable. Use extreme caution when the AED is on and charged or whenever the case is open.

Equipment Required

Defibrillator Analyzer capable of measuring trapezoidal waveform outputs that also provides a Ventricular Fibrillation waveform. Confirm that the Load resistor selected is 50 ohms (for analyzers where the load resistor is adjustable).

Procedure

1. Connect the Defibrillator Analyzer to the Pad cable.
2. Set the Defibrillator Analyzer for Ventricular Fibrillation output.
3. Turn on the MRL AED, confirm that the display indicates SHOCK ADVISED and that the defibrillator charges to the initial preselected energy that was setup in the Supervisor manual (Note the factory default is 200 Joules).
4. Discharge the AED by pressing the flashing shock button after the AED has indicated that it has reached the charged state.
5. Record the delivered energy.

Acceptable Results

The maximum acceptable error is +/- 10% or within 2 joules, whichever is greater.

Corrective Action

If energy measurements are not within tolerance, verify that the analyzer is accurate when measuring a truncated exponential waveform defibrillator.

Not all defibrillation analyzers are capable of measuring truncated exponential waveforms or biphasic waveforms.

Contact an authorized MRL service center for assistance.

Defibrillator Charge Time

Caution

Lethal voltages can be present inside the AED and at the AED Pads and cable. Use extreme caution when the AED is on and charged or whenever the case is open.

Equipment Required

Stop watch

Procedure

1. Make sure the battery inserted in the MRL AED is fully charged and the battery indicator on the MRL AED display is Full.
2. Connect the Defibrillator Analyzer to the Pad cable.
3. Set the Defibrillator Analyzer for Ventricular Fibrillation output.
4. Turn on the MRL AED and confirm that the display indicates ANALYZING.
5. When the display indicates SHOCK ADVISED - CHARGING, start the stop watch.
6. Stop the timing when the display indicates charge completion (i.e. when the display indicates CHARGED, the bar graph reaches the selected energy or the intermittent tones change to continuous charge ready tone.
7. Discharge the AED by pressing the flashing shock button and record the time.
8. Repeat steps 5, 6, and 7 for ten shocks. Record the time for each cycle. Note the MRL AED will enter a 60 second CPR mode after every third shock. The AED will automatically resume analyzing after 60 seconds have elapsed.

Acceptable Results

The charge time should not exceed 10 seconds.

Corrective Action

Verify that the battery has been fully charged and that the battery status indicator on the display indicates a full battery state.

Contact an authorized MRL service center for assistance.

Chapter 5

Troubleshooting

MRL LifeQuest AEDefibrillator Service Manual

This chapter provides information on how to troubleshoot situations and conditions that arise during the operation of the MRL LifeQuest AEDefibrillator.

Troubleshooting the MRL AED **5-2**

Troubleshooting the MRL AED

If the built-in sensors in the MRL AED detect a problem prior to or during operation, the unit provides a voice or screen test prompt indicating the nature of the problem.

Use the information in the following tables to troubleshoot some of the common faults, determine the probable cause, and get guidance as to the corrective actions to take.

Common problems that can be corrected by the user:

Malfunction	Probable Cause	Corrective Action
Low Battery Prompt or Flashing System Ready Indicator	Depleted battery	Replace battery with a fully charged rechargeable or unopened non-rechargeable battery.
MRL LifeQuest AEDefibrillator Operates, but display is unreadable	Contrast needs to be adjusted	Adjust Contrast using the contrast button on the front panel menu bar.
	Unit stored or operated outside of the recommended temperature zone	Operate the unit between 0° and 50°C (32° to 122°F).
"Apply Defib Pads" prompt	Defibrillator pads not properly applied to patient	Backing must be removed from pads and pads must be firmly adhered to patient's bare chest. Wipe moisture and/or shave excessive hair from the patient's chest.
	Pads not connected to defibrillator cable	The Pads connector must be firmly seated into the MRL LifeQuest AEDefibrillator cable connector.
	Defibrillator cable not properly connected to the MRL LifeQuest AEDefibrillator	Push defibrillator cable connector firmly into the MRL LifeQuest AEDefibrillator socket.
	Pads, cable, or connector damaged	Inspect pads, cables, and connectors and replace if necessary.

Malfunction	Probable Cause	Corrective Action
System Ready indicator displays No-Go indication	Battery not properly inserted	Push the battery into the unit until it clicks and locks into place.
	Self-test failure	Turn on power to the defibrillator and note the self-test result displayed on the screen. The unit may be used if any of the following messages are displayed: - Setup Defaults Restored - Internal Battery Low Do **not** use the unit if any other messages are displayed. Contact authorized service personnel.
	Severely depleted battery	Replace battery.
“Motion Detected, Analyzing Interrupted” prompt	Patient movement (CPR, tremor etc.)	Stop CPR or patient motion if possible.
	Transportation in moving vehicle	Minimize patient movement, or, if possible, stop vehicle during analysis.
"Defib Comm failed" message	Cable - Defib Main is disconnected, faulty, or damaged	Replace Cable - Defib Main, Item 23 (550772)
	Defib module error	Replace Defib Module, Item 3 (596395)
	Main board error	Replace Main Board, Item 11 (590374)
"Defib cable failed" message	Cable - Defib Main is disconnected, faulty or damaged	Replace Cable - Defib Main, Item 23 (550772)
	Defib module error	Replace Defib Module, Item 3 (596395)
	Main board error	Replace Main Board, Item 11 (590374)
Defib Fail error 01,02	Fire switch panel error	Replace AED Front enclosure, Item 12 (570634)
	Defib module error	Replace Defib Module, Item 3 (596395)

Malfunction	Probable Cause	Corrective Action
Defib Fail error 03,04,05,06,07, 08,09,0A	Defib module error	Replace Defib Module, Item 3 (596395)
Defib Fail error 0B	Defib module error	Replace Defib Module, Item 3 (596395)
	Main board error	Replace Main Board, Item 11 (590374)
Defib Fail error 0C	Disconnected bulk 12 Volt cable	Check Bulk 12 Volt conn. to Main board J12 conn.
	Defib module error	Replace Defib Module, Item 3 (596395)
	Main board error	Replace Main Board, Item 11 (590374)
Defib Fail error 0D	Defib module error	Replace Defib Module, Item 3 (596395)
Defib Fail error 0E	Defib module error	Replace Defib Module, Item 3 (596395)
Failure to charge	Cable - Defib Main disconnected, faulty, or damaged	Replace Cable - Defib Main, Item 23 (550772)
	Defib module error	Replace Defib Module, Item 3 (596395)
	Main board error	Replace Main Board, Item 11 (590374)
Delivers low energy	Defib module error	Replace Defib Module, Item 3 (596395)
Unable to set defibrillator energy	Failure of menu switch on Front enclosure	Replace AED Front enclosure, Item 12 (570634)
Failure to deliver energy	Defib module error	Replace Defib Module, Item 3 (596395)
	Faulty or damaged pads	Check pads expiration date
	Faulty or damaged ECG output cable	Inspect cable, Item # (550774)
"Preamp cable fail" message	Cable - AED Preamp disconnected, faulty, or damaged	Replace Cable MB - Preamp FFC, Item 19 (550770)
	Preamp board error	Replace Preamp Board, Item 8 (590375)
	Main board error	Replace Main Board, Item 11 (590374)

Malfunction	Probable Cause	Corrective Action
"ECG Comm Error" message	Cable - AED Preamp disconnected, faulty, or damaged	Replace Cable MB - Preamp FFC, Item 19 (550770)
	Preamp board error	Replace Preamp Board, Item 8 (590375)
	Main board error	Replace Main Board, Item 11 (590374)
Artifact on ECG	Faulty or damaged pads	Check pads expiration date. Inspect cable
	Preamp board error	Replace Preamp Board, Item 8 (590375)
Loss of ECG signal	Faulty or damaged pads	Check pads expiration date. Inspect cable
	Preamp board error	Replace Preamp Board, Item 8 (590375)
"Attach pads" message	Bad contact between pads and skin	Check and replace the pads if needed
	Preamp board error	Replace Preamp Board, Item 8 (590375)
	Faulty or damaged ECG output cable	Inspect cable, Item # (550774)
"Setup defaults restored" message	Bad or low 3 V lithium battery	Replace 3 V battery, Item 13 (800868)
	Main board error	Replace Main Board, Item 11 (590374)
"Key Fail" message	Failure of menu switch on Front enclosure	Replace AED Front enclosure, Item 12 (570634)
	Main board error	Replace Main Board, Item 11 (590374)
"PS_Comm" message	Main board error	Replace Main Board, Item 11 (590374)
"Replace 3 V Batt" message	Bad or low 3 V lithium battery	Replace 3 V battery, Item 13 (800868)
	Main board error	Replace Main Board, Item 11 (590374)
"Batt_type_error" message or wrong battery icon displayed.	Bad or disconnected sense wire	Repair or replace sense wire on AED Front Enclosure, Item 12
	Main board error	Replace Main Board, Item 11 (590374)

Malfunction	Probable Cause	Corrective Action
Unit won't power on	Main board error	Replace Main Board, Item 11 (590374)
	Bad battery plug-in contact	Replace AED Back Enclosure, Item 1 (590635)
	Jumper in wrong position	Check jumpers JP14 and JP7 on item 11
No display	Main board error	Check voltage on F4 on Main Board, item11. If voltage is not -17.5 to -23.5V, Replace Main Board, Item 11 (590374)
	Damaged or bad display	Replace AED Front enclosure, Item 12 (570634)
Display problem	Damaged or bad display	Replace AED Front enclosure, Item 12 (570634)
	Main board error	Replace Main Board, Item 11 (590374)
No sound	Bad speaker contacts	Replace AED Front enclosure, Item 12 (570634)
	Main board error	Replace Main Board, Item 11 (590374)
Distorted sound	Main board error	Replace Main Board, Item 11 (590374)
	Bad or damaged speaker	Replace AED Front enclosure, Item 12 (570634)
No speech	Main board error	Replace Main Board, Item 11 (590374)
Unit freezes up/resets	Jumpers in wrong positions	Check the jumper JP7 on item 11 (590374)
	Main board error	Replace Main Board, Item 11 (590374)
		Replace AED Front enclosure, Item 12 (570634)
Status LCD does not operate properly	Bad Status LCD contact	Repair contact or replace Front Enclosure, Item 12 (570634)
	Status LCD Malfunction	Replace AED Front enclosure, Item 12 (570634)
	Main board error	Replace Main Board, Item 11 (590374)

Malfunction	Probable Cause	Corrective Action
Unit does not keep time	Bad or low 3 V lithium battery	Replace 3 V battery, Item 13 (800868)
	Main board error	Replace Main Board, Item 11 (590374)
Unit does not record data to card	Card write protect switch ON	Check write protect switch
	Defective card	Check card on PC or another device. Replace card if needed
	Main board error	Replace Main Board, Item 11 (590374)
Unit does not recognize valid card type	Defective card	Check card on PC or another device. Replace card if needed.
	Main board error	Replace Main Board, Item 11 (590374)
		Replace AED Front enclosure, Item 12 (570634)
Shock Button LED does not light	Defective Switch Panel	Replace AED Front enclosure, Item 12 (570634)
	Main board error	Replace Main Board, Item 11 (590374)
Display is too dark/light	The unit is operated at temperature outside of specified range	Adjust the contrast setting. If unable to read display, allow unit to attain temperature within the specified operating range.
	Main board contrast voltage out of range	At room temperature, adjust R328 on the Main Board, Item 11, for optimal contrast.
	Main board error	Replace Main Board, Item 11 (590374)
	Display Malfunction	Replace AED Front enclosure, Item 12 (570634)

Malfunction	Probable Cause	Corrective Action
Failure to Print	Incorrect or broken adapter	Check adapter and Baud Rate settings (590469 or 900412A)
	Incompatible printer	Check for MRL approved printer
	Incorrect Log Setup selection	Select Text or ECG at the correct Baud Rate in the Log>Setup Menu
	Incorrect or broken Cable	Check or replace correct cable, (551778 or 550786)
	Defective connector on AED	Replace bottom enclosure
	Main board Error	Replace Main Board, Item 11 (590374)

Chapter 6

Theory of Operation

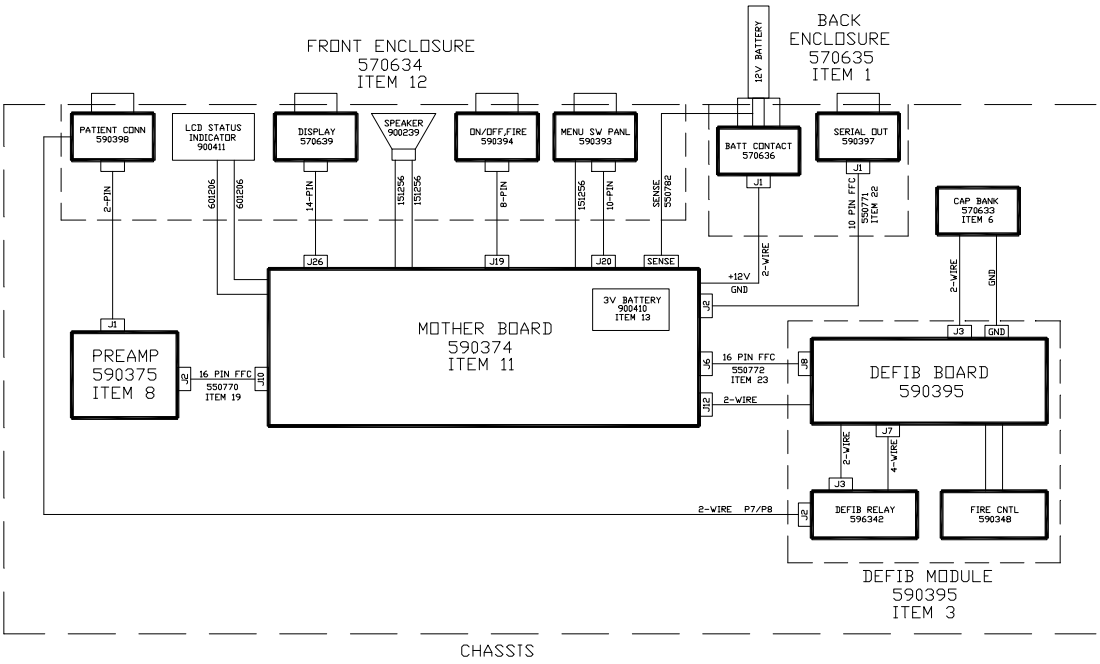
MRL LifeQuest AEDefibrillator Service Manual

This chapter presents the theory of operation for the MRL AED. The system is described in terms of its main assemblies.

General	**6-2**
Power Distribution	**6-3**
Motherboard	**6-3**
ECG Monitor	**6-4**
LCD	**6-5**
Switch Panels	**6-5**
Voice Prompts and Audio Recording	**6-5**
PCMCIA Interface	**6-5**
Defibrillator	**6-6**

General

Use the following interconnect diagram as a reference when reviewing the theory of operation information presented in this chapter. Refer to the Assembly Drawings in Chapter 8 for placement and configuration of the items described in the theory of operation.



The MRL AED system is described in terms of the following assemblies:

- Power Distribution
- Motherboard
- ECG Monitor
- LCD
- Switch Panels
- PCMCIA Interface
- Defibrillator

Power Distribution

The AEDefibrillator can be powered from either a rechargeable or non-rechargeable battery or an AC Power Adapter. Both the battery and the AC Adapter connect to the unit via two contacts in the Back Enclosure (Item 1). The power from the battery is routed from the battery contacts to the Motherboard (Item 11) via a 2-wire cable. This supply is fused with a 15A fuse on the Motherboard. An additional sense contact in the Front Enclosure (Item 12) is used to identify the power source (rechargeable battery, non-rechargeable battery, or AC Adapter).

The Motherboard (Item 11) contains switching supplies to generate +5VDC and +12VDC. These power signals are then distributed to the ECG preamp (Item 8) and Defibrillator module (Item 3).

The unregulated voltage from the battery (9.8 to 13.5 VDC) or AC Adapter is used to supply power to charge the defibrillator. This signal is routed to the Defibrillator Module (Item 3) through a 2-wire cable connected to J12 of the Motherboard. This unregulated voltage is monitored while running on battery power. When the battery voltage dips below 11.7VDC for a 20 second period, a Low Battery condition will be indicated. When this voltage dips below 9.8VDC, the power supply will shut the unit down.

In addition, a 3V battery (Item 13) on the Motherboard is used to power the clock, the power supply processor, and to maintain battery-backed-up static RAM on the Motherboard (Item 11). The battery-backed-up RAM contains configuration parameters and the Treatment Log data. If the 3V battery (Item 13) is discharged, or if JP14 is removed from the Motherboard (Item 11), the data in the Static RAM will be lost and the default configuration parameters will be restored. Replacement boards are shipped with the shorting plug for JP14 removed. Install the shorting plug on JP14 after installing a new Motherboard.

The power supply is turned on by pressing the ON/OFF Switch on the front of the AED unit. The ON/OFF switch panel is connected to J19 of the Motherboard. Power Supply switching and battery level detection are done by the Power Supply Processor on the Motherboard (Item 11).

Motherboard

The main microprocessor for controlling the display, Memory Card PCMCIA port, switch panels, speech processor, and for communicating with the other modules, resides on the Motherboard (Item 11). The Motherboard also contains the Time-Date clock and the battery-backed-up memory containing the configuration parameters and treatment Log data. The processor on the Motherboard monitors the battery condition and the power source, and displays a battery gauge, low battery icon, or an AUX power indicator on the display to indicate power status. The Motherboard

maintains product Serial number data and purchased options in non-volatile Flash memory.

The Motherboard (Item 11) communicates user input to the Defibrillator Module (Item 3) via a serial bus through a 16-pin FFC cable (Item 23) connected to J6 of the Motherboard and J8 of the Defibrillator Module. The +5VDC used to power the Defibrillator microprocessor and the Fire switch contacts are also routed through Item 23.

Likewise, the Motherboard (Item 11) communicates user input to the ECG Preamp Board (Item 8) via an opto-isolated serial bus through a 16-pin FFC cable (Item 19) connected to J10 of the Motherboard and J2 of the ECG Preamp Board. The +5VDC is routed to the ECG Preamp Board to power the optocouplers and digital buffers. The rest of the ECG Preamp board is powered through an isolated supply by the 12VDC supply.

The Motherboard also contains the Power Supply processor, which monitors the ON/OFF switch, and determines battery type and level. The Power Supply processor also communicates with the Time/Date Clock, controls the status indicator LCD, and wakes up the system daily to run self-tests. The Power Supply processor and Time/Date clock are always running in standby mode and drawing current from the 3V battery whenever the JP14 jumper is shorted. When the Power Supply processor wakes up, or the ON/OFF switch is pressed, these components draw current from the main 12V battery.

ECG Monitor

ECG signals can be monitored from the multi-function defibrillator pads. ECG signals from the AED Output Cable (Item 32) pass through the Patient Connector in the Front Enclosure (Item 12) to J1 of the ECG Preamp Board (Item 8).

The ECG Preamp Board (Item 8) contains ECG gain and filtering circuitry, lead fault detection circuits, and pace detection/blanking circuits. An A/D converter on the ECG Preamp Board samples and digitizes the ECG and sends the data to the Motherboard (Item 11) via an opto-isolated serial bus. Communication to the Motherboard passes through a 16-pin FFC cable (Item 19) connected to J10 on the Motherboard and J2 of the ECG Preamp Board.

The optocouplers and digital buffers on the ECG Preamp Board are powered by +5VDC. The rest of the ECG Preamp board is powered through an isolated supply by the 11VDC supply. The 11VDC supply is fused on the ECG Preamp Board.

LCD

The LCD Display is controlled by the main processor and a display co-processor on the Motherboard (Item 11). Display control signals and the +5DC power signals are routed to the LCD Display through a 14-pin in-line header J26. The LCD Display is mounted in the Front Enclosure Assembly (Item 12).

The Motherboard contains a digital potentiometer for contrast adjustment, switching circuits to enable the display power supplies, and an adjustable LCD bias voltage power supply. The 12VDC signal is switched by a transistor and then converted to a -17.5 to -23.5 bias voltage by a switching supply. The bias voltage and coarse contrast can be adjusted by R328. The LCD bias voltage is fused by F4 on the Motherboard.

Switch Panels

The ON/OFF Switch Panel and Menu Switch Panel are monitored by the main processor on the Motherboard (Item 11). The ON/OFF Switch Panel also contains the Fire switch and is connected to J19 on the Motherboard. The Fire switch contacts are routed to the Defibrillator module (Item 3) via a 16-pin FFC cable, Item 23.

The Menu switch panel contains four momentary switches and is connected to J20 on the Motherboard (Item 11). The switches are normally open and are pulled low through resistors on the Motherboard (Item 11). Pressing a switch shorts an input signal to the 5V supply. The main processor checks the Front Switch Panel for stuck keys at power-up and during weekly self tests.

Voice Prompts and Audio Recording

Voice Prompts are controlled by the main processor and a speech co-processor on the Motherboard (Item 11). Audio recordings detected from the microphone on the Motherboard are stored on the PCMCIA data card, if installed. The Motherboard also generates the audible voice prompts during AED mode. The voice prompts and audible tones are routed to the speaker in the Front Enclosure Assembly (Item 12) through two spring contacts on the Motherboard (Item 11).

PCMCIA Interface

The AEDefibrillator stores detailed treatment data, audio, and status on the PCMCIA Data Card through J4 on the Motherboard (Item 11). Software updates and configuration parameters also may be programmed through the PCMCIA Data Card.

Defibrillator

The Defibrillator Module (Item 3) controls the functions of energy selection, charging, and firing the defibrillator. The Defibrillator module transmits to and receives commands from the Motherboard (Item 11) through a serial bus via the Defib-Motherboard Cable (Item 23). The defibrillator continuously checks communications integrity and requires that communication be established for operation.

The defibrillator uses a capacitor bank to store enough charge to deliver the properly formed energy pulse to the patient. The charge is initiated automatically in AED mode or by pressing the front panel charge switch in Manual mode. The Motherboard (Item 11) sends a message to the defibrillator, initiating the charge sequence. Power for the defibrillator is provided directly from the battery through the 12-Volt cable that connects to J12 on the Motherboard (Item 11). If this bulk power is not present, the defibrillator will display a Defib Error 0C on the display. The defibrillator updates the Selected Energy display and Energy Bar as it is charging. When the defibrillator has stored the proper amount of energy, it will accept the fire command from the Fire Switch. To deliver energy to the patient, the defibrillator first activates the appropriate transfer relays connecting the patient to the defibrillator though the Output Cable (Item 32), the Patient Connector cable connected to J2 of the Relay Board (Item 3), and the Defib Output cable connected to J3 (Apex/Sternum) of the Relay Board. Once the connection is established, the defibrillator activates Solid State devices that connect the patient to the Capacitor Bank (Item 6). The energy stored on the Capacitor Bank (Item 6) is routed to J3 of the Defibrillator Module (Item 3) via a 2-wire cable. The defibrillator monitors the energy being delivered and terminates the pulse at the appropriate time.

Chapter 7

Removal and Replacement Instructions

MRL LifeQuest AEDefibrillator Service Manual

This chapter provides removal and replacement of field replaceable assemblies for the MRL LifeQuest AED system .

General	**7-2**
Enclosure	**7-3**
Defibrillator Module (Item 2)	**7-5**
Capacitor Bank (Item 6)	**7-7**
Pre-Amplifier Module (Item 8)	**7-8**
Bridge, Seal/AED Housing (Item 10)	**7-9**
Motherboard, PCD Assembly/AED Main Board (Item 11)	**7-10**
Cable, AED Motherboard Pre-Amplifier (Item 19)	**7-12**
Ferrite Board (Item 21)	**7-13**
Cable, AED Motherboard/Serial, FFC (Item 22)	**7-14**
Cable, AED Defib Main Board (Item 23)	**7-15**

General

The procedures provided in this chapter are for the removal and replacement of field replaceable items. If the MRL AED needs to be returned for servicing, use the original shipping container. If the shipping container is not available, please contact MRL for packing instructions prior to shipping so that the unit is not damaged in shipping.

The first procedure covers the steps to follow when opening and closing the MRL AED enclosure. Other instructions are presented in order of the component item numbers as shown in the Assembly Drawings.

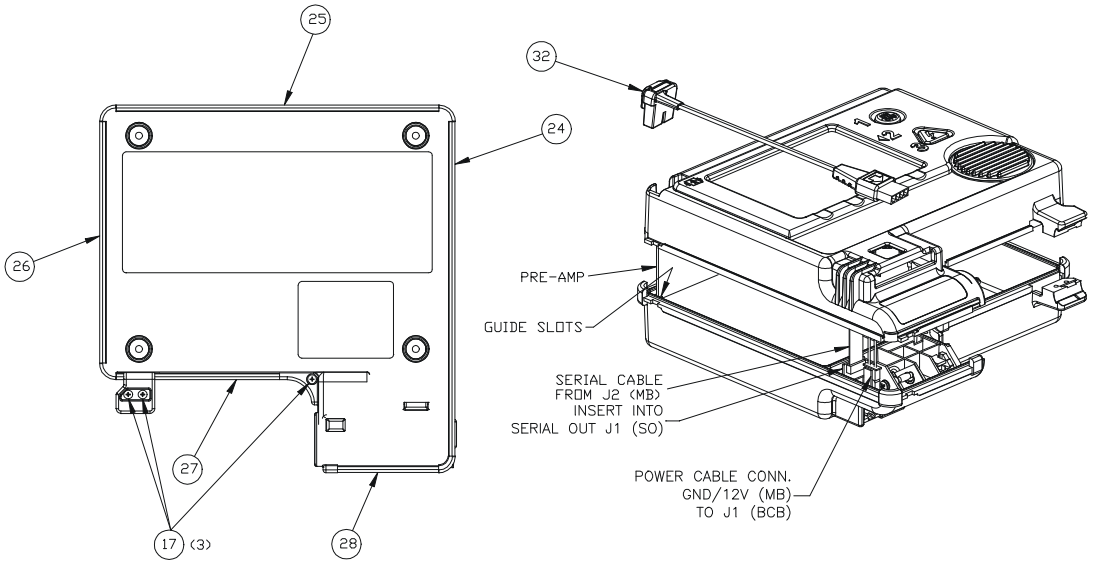
Removal and replacement instructions are provided for the following components:

- Defib Module (Item 2)
- Capacitor Bank (Item 6)
- Pre-Amplifier (Item 8)
- Bridge, Seal/AED Housing (Item 10)
- Motherboard, PCD Assembly/AED Main Board (Item 11)
- Cable, AED Motherboard Pre-Amplifier (Item 19)
- Ferrite Board (Item 21)
- Cable, AED Motherboard/Serial, FFC (Item 22)
- Cable, AED Defib Main Board (Item 23)

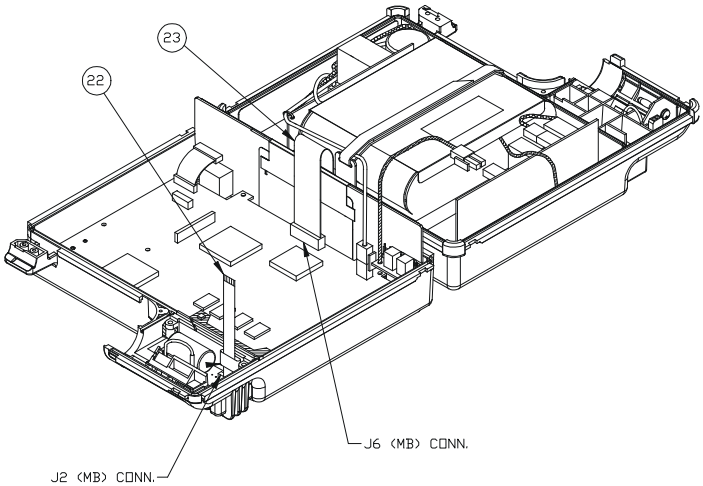
Refer the Assembly Drawings in Chapter 8 when servicing the MRL AED.

Enclosure

Open



1. Remove (3) screws, item 17.
2. Remove the rails, items 24, 25, 26, 27, and 28, from the joints at the enclosure halves. (Use a utility knife to split down the middle.)
3. Separate the enclosure halves carefully, taking care to pull the pre-amp connections straight out of the mating connections on the back enclosure.
4. Disconnect the power cable (MB GND/+12V) from the battery connector board assembly (BCB J1).
5. Disconnect the serial cable, item 22, from the back enclosure assembly (SO J1).

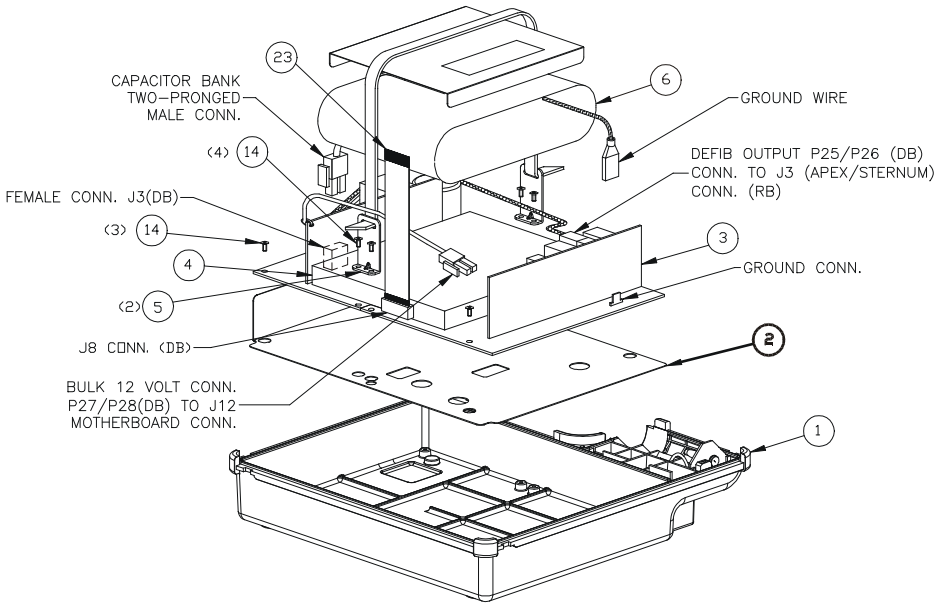


6. Disconnect the relay board output cable (PCB J1) from the relay board (RB J2).
7. Disconnect the defib module's bulk 12 volt cable (DB P27/P28) from the motherboard (MB J12).
8. Disconnect the defib serial cable, item 23, from the motherboard (MB J6).

Closure

1. Connect defib cable, item 23, to the motherboard, routing it over the pre-amp.
2. Connect the bulk 12 volt cable (DB P27/P28) from the defib board to the motherboard (MB J12).
3. Connect the relay board output cable (PCB J1) from the patient connector board to the relay board (RB J2) on the defib module.
4. Put the front and back enclosure assemblies together, sliding the pre-amp into the guide slots on the back enclosure assembly. Leave enough space at the top of the enclosure halves to connect the serial cable, item 22 to the serial connector (SO J1) in the back enclosure assembly.
5. Connect power cable (MB GND/+12V) from the motherboard to the battery connector board assembly (BCB J1). Guide the serial and power cables into enclosure cavities so they don't prevent the case from fully closing.
6. Make sure the front enclosure assembly is fully seated on the back enclosure assembly.
7. Slide the rails, items 24, 25, 26, 27, and 28, onto the joints at the enclosure halves.
8. Install (3) screws, item 17.

Defib Module (Item 2)



Remove

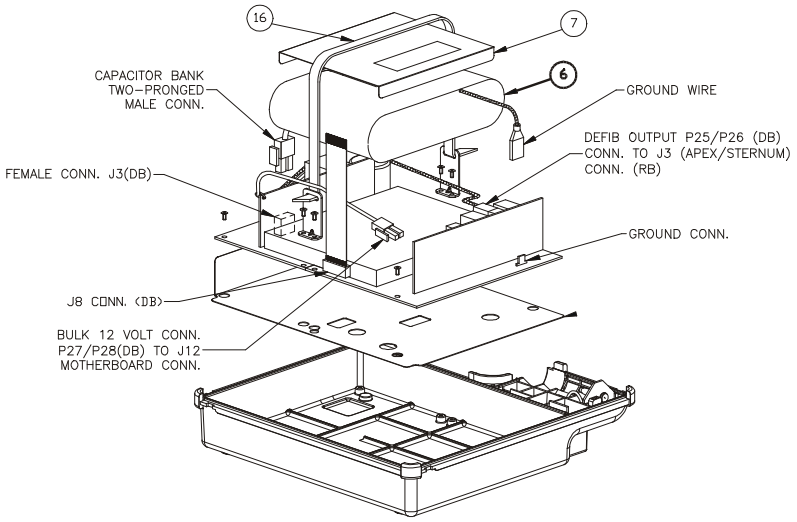
1. Remove capacitor bank, item 6.
2. Disconnect the defib output Wire (DB P25/P26) from the relay board (RB J3).
3. Remove the foam pad, item 4.
4. Remove (4) bracket screws, item 14, from the (2) brackets, item 5, and remove brackets.
5. Disconnect the defib serial cable, item 23, from the defib module (DB J8).
6. Remove (3) screws, item 14.
7. Remove the defib module, item 3.

Replace

1. Install defib barrier, item 2, in the back enclosure, item 1, so the posts match up with the holes.
2. Install defib module, item 3, so the circuitry is facing up and screw holes match. Affix with (3) screws, item 14.
3. Install defib communication cable, item 23, with the conductors facing inwards, in the defib module (DB J8).

4. Install (2) cap mounting brackets, item 5, so the short legs through which the screws are installed both face away from the battery pack/handle side of the enclosure. Mount using (2) screws, item 14, per bracket.
5. Install foam pad, item 4, so the fit between cap brackets is snug and the pad is relatively centered with the brackets.
6. Route the defib output wire (DB P25/P26) along the inside of the cap bracket along the edge of the foam pad near the battery pack/handle. Plug the male connector into the female connector (RB J3) nearest to the battery pack/handle, on the relay board.
7. Thread the Velcro ribbon, item 16, loosely through the slots on the capacitor brackets.
8. Install capacitor bank, item 6.
9. Install tie wrap, item 29, through the corner hole on the fire control board and secure the bulk 12 volt cable (DB P27/P28).

Capacitor Bank (Item 6)



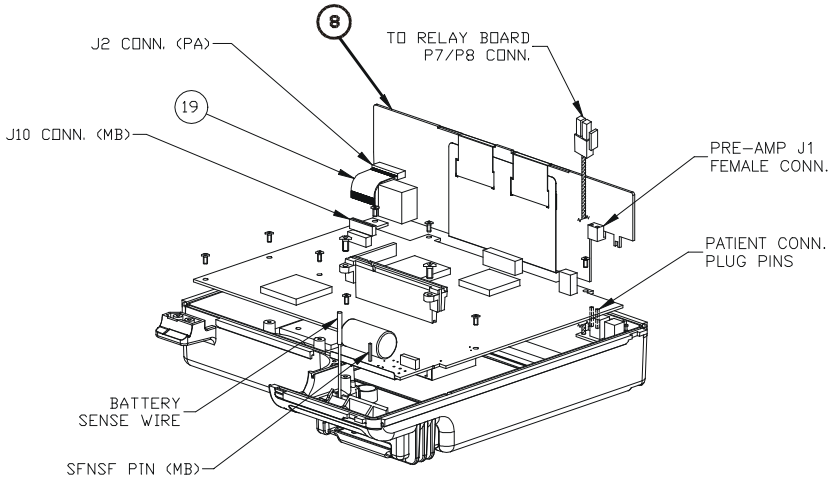
Remove

1. Loosen the Velcro strap, item 16.
2. Remove the barrier, item 7.
3. Disconnect the two pronged male connector coming out of the capacitor bank from the defib module (DB J3).
4. Disconnect the ground wire coming out of the capacitor bank from the defib module (DB Gnd).
5. Remove the capacitor bank, item 6.

Replace

1. Mount the capacitor bank with the exposed barrier facing the foam pad. The capacitor bank should fit snugly between the brackets. The smaller wire should exit the capacitor bank over the relay board.
2. Plug the ground wire on to the ground connector on the defib board.
3. Route the cap bank two-pronged male connector on the other side of the cap bank over the fire control board and two existing wires on the defib board and plug into female connection (DB J3).
4. Place barrier item 7, under the loose strap and over the capacitor bank with the flaps facing down. Pull the Velcro strap tight from both sides and fold the end going through the bracket furthest from the battery plug – in area over the bulk 12 volt cable. Strap both sides tightly.

Pre-Amplifier (Item 8)



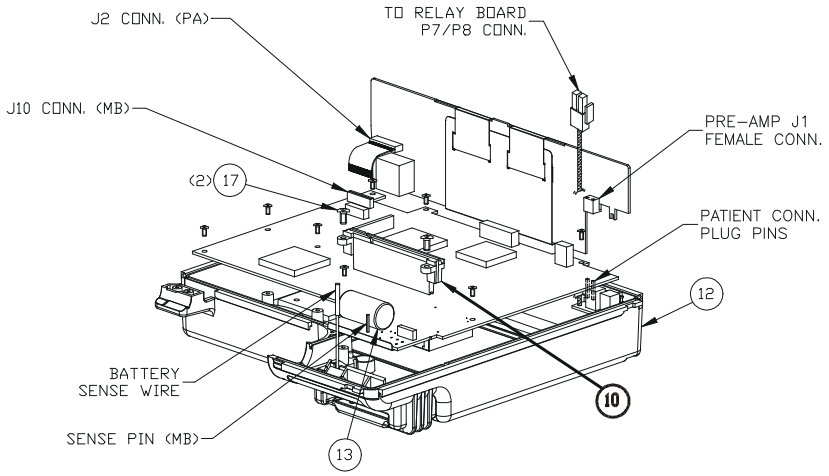
Remove

1. Disconnect cable, item 19, from the motherboard (MB J10).
2. Remove pre-amp, item 8, from the front enclosure, sliding the female connector (PB J1) from the patient connector plug pins. Note the pre-amp is secured to the enclosure with double-sided tape.

Replace

1. Connect cable, item 19, with the conductors facing down, into pre-amp connector (PB J2).
2. Install pre-amp into front enclosure by sliding the female connector onto the patient connector plug pins.
3. Connect cable, item 19, into motherboard connector (MB J10).

Bridge, Seal/AED Housing (Item 10)



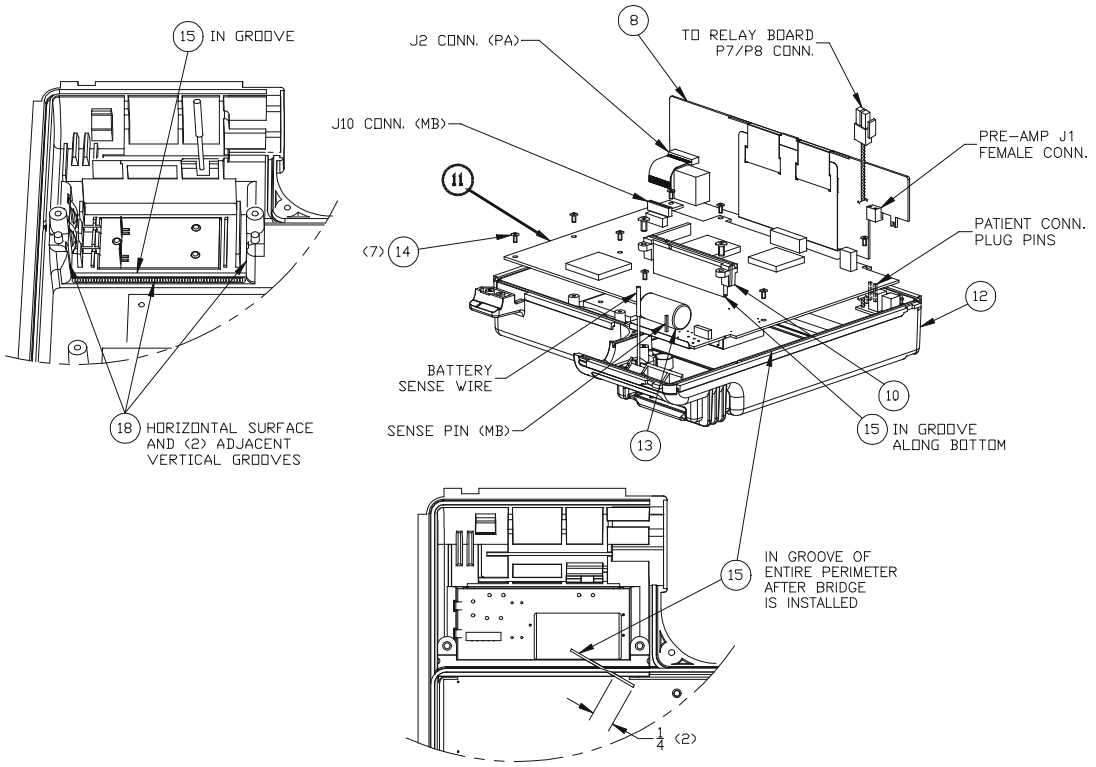
Remove

1. Remove (2) screws, item 17.
2. Remove bridge, item 10, and remaining RTV from the front cover sealing surfaces around the bridge.

Replace

1. RTV, item 13, the mating groove between the bridge, item 10, and the front enclosure, item 12.
2. Install bridge, item 10, with (2) screws, item 17.
3. Seal joints between the bridge, item 10, and the front enclosure, item 12, with RTV conformal coating, item 18.

Motherboard, PCB Assembly AED Main Board (Item 11)



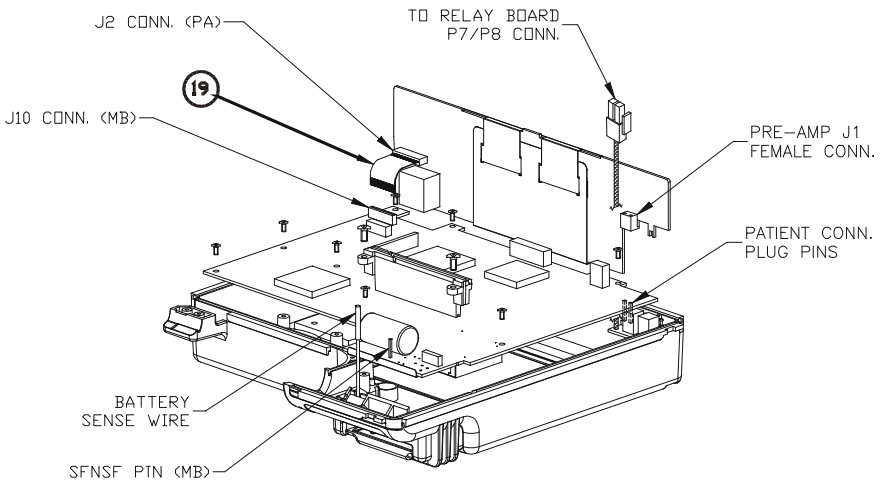
Remove

1. Remove item 8.
2. Remove gasket, item 15, from the groove around the perimeter of the enclosure.
3. Remove item 21.
4. Remove item 10.
5. Remove item 22.
6. Disconnect the battery sense wire from the motherboard (MB Sense).
7. Remove (7) screws, item 14.
8. Remove motherboard, item 11.
9. Remove remaining RTV from the front enclosure motherboard and bridge sealing surfaces.

Replace

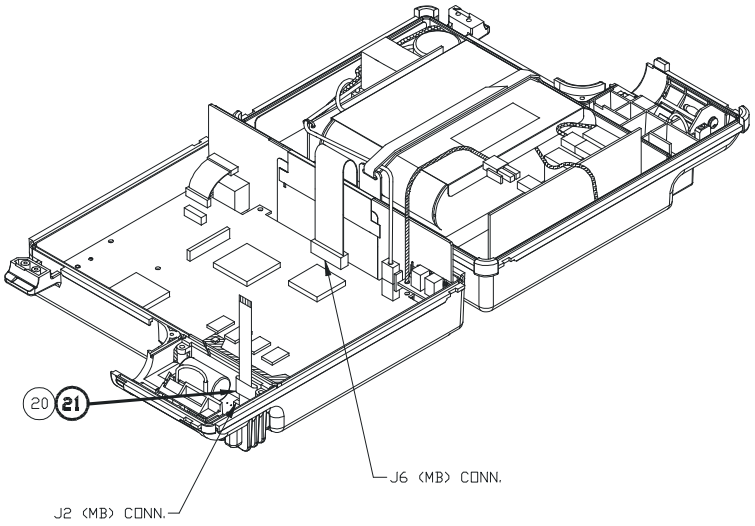
1. Apply RTV, item 13, to the front enclosure motherboard and bridge sealing surfaces.
2. Install motherboard, item 11, with (7) screws, item 14.
3. Connect the battery sense wire to the motherboard sense pin (MB sense).
4. Replace item 10.
5. Replace item 22.
6. Replace item 21.
7. Install gasket, item 15, in the groove around the perimeter of the enclosure.
8. Replace item 8.

Cable, AED Motherboard / Pre-amplifier (Item 19)



Cable, item 19, from the motherboard (MB J10) to pre-amp (PB J1) should be connected with the conductors facing down.

Ferrite Bead (Item 21)

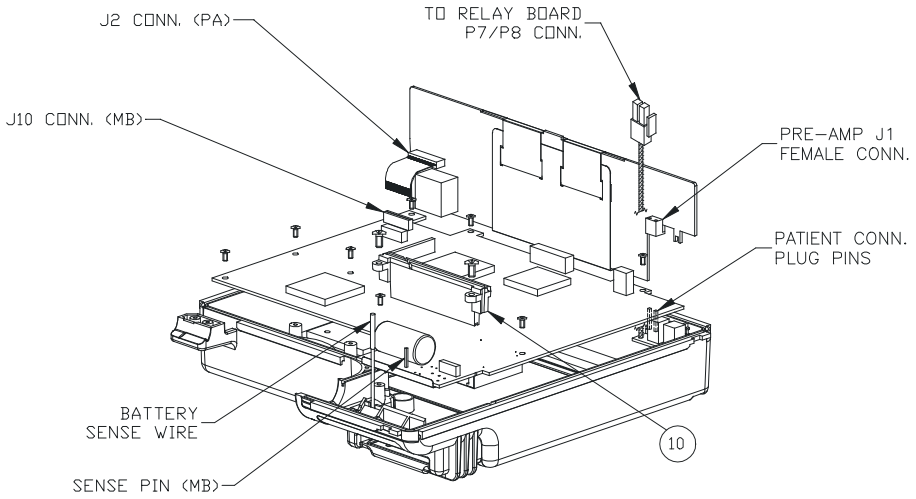


Remove

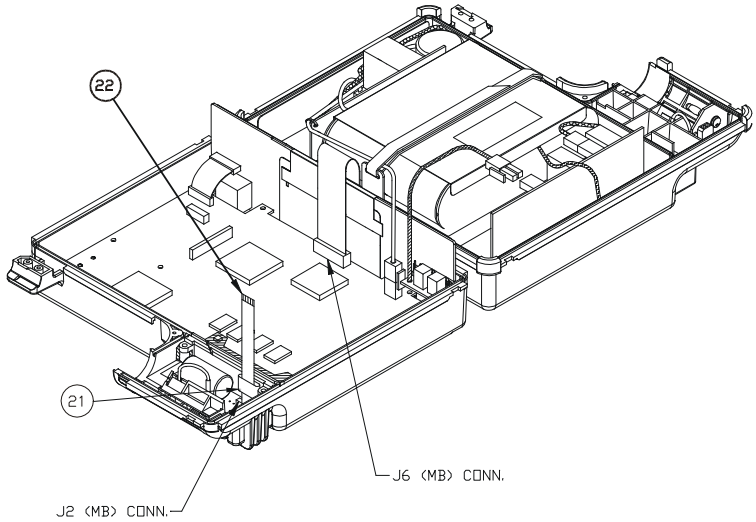
1. Remove the double-sided tape, item 20, from the bridge, item 10.
2. Slide the ferrite bead, item 21, off the cable.

Replace

1. With double-sided tape, item 20, adhered to ferrite bead, item 21, slide the ferrite bead over the cable.
2. Attach ferrite bead, item 21, to bridge, item 10.



Cable, AED Motherboard / serial, FFC (Item 22)



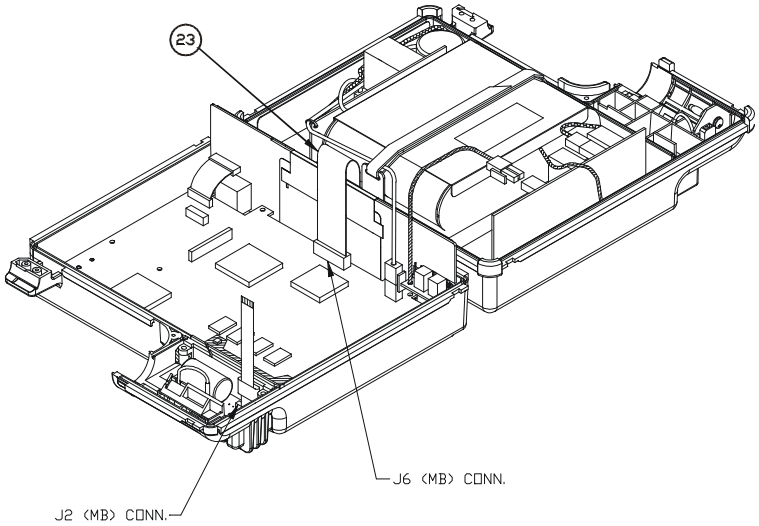
Remove

1. Remove item 21.
2. Disconnect the cable, item 22, from the serial port on the motherboard (MB J2).

Replace

1. Connect the cable, item 22, with the top conductor facing out, to the serial port on the motherboard (MB J2).
2. Replace Item 21.

Cable, AED, Defib Main (Item 23)



The defib serial cable, item 23, from the defib board (DB J8) to the motherboard (MB J6) should be connected with the defib side conductors facing the defib board.

Chapter 8

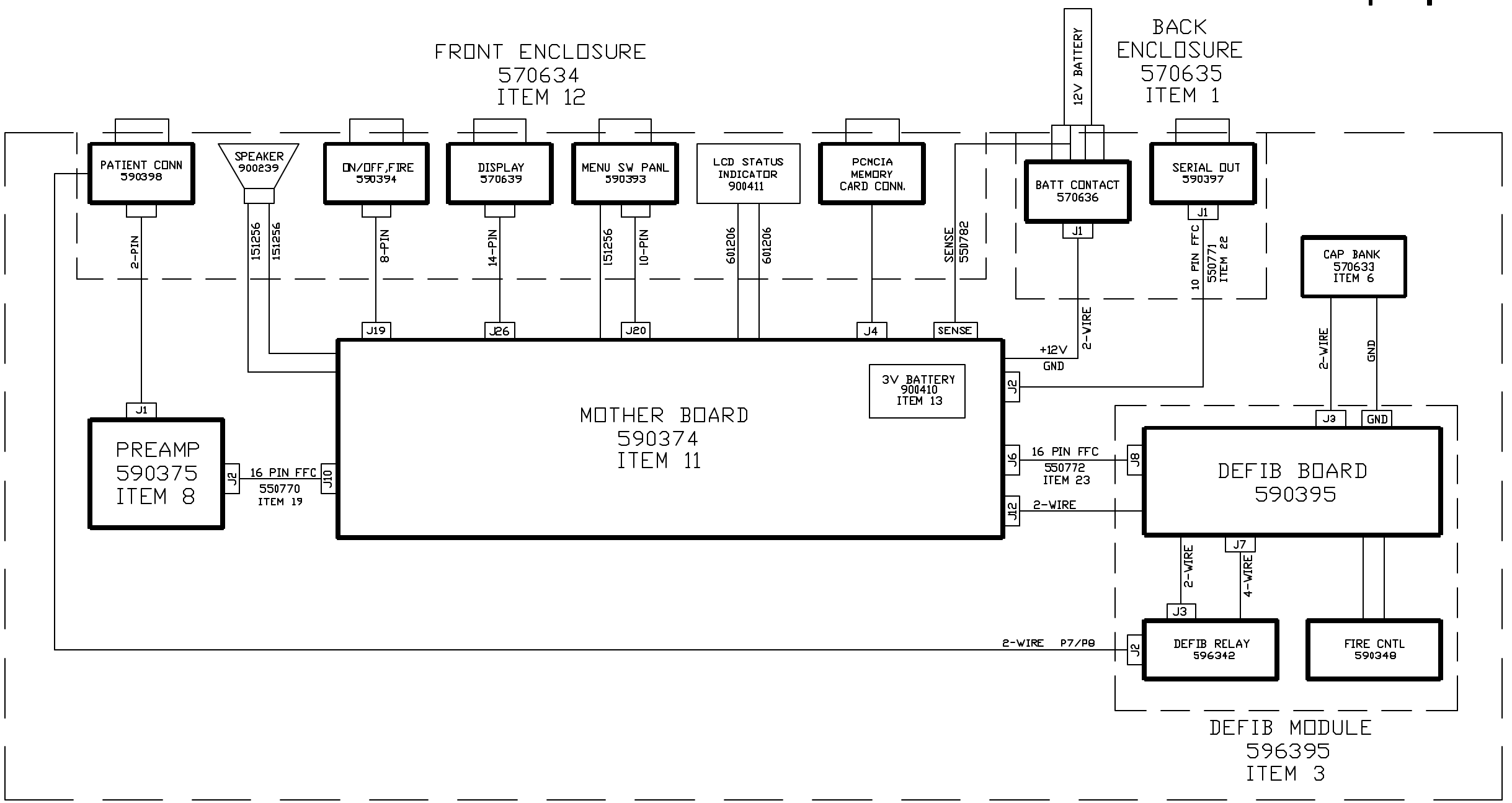
Drawings

MRL LifeQuest AEDefibrillator Service Manual

This chapter contains diagrams and drawings for the MRL LifeQuest AEDefibrillator Service Manual.

Interconnection Diagram	**8-1**
Assembly Drawings	**8-2**

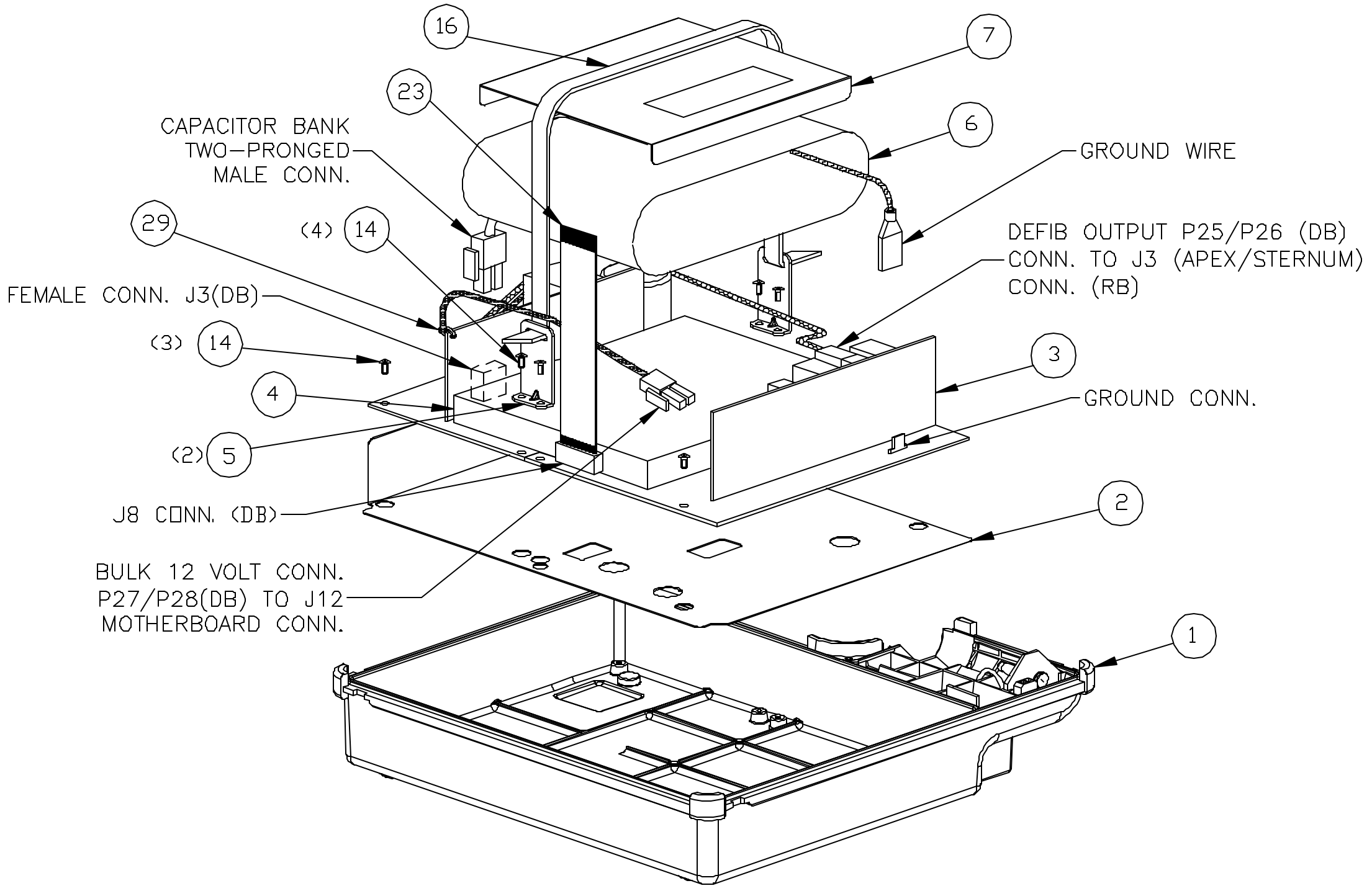
ISSUE	DESCRIPTION	INITIALS	DATE
A	ECO #2527 RELEASE	KDM	12/00



MRL medical research laboratories, inc.

TITLE	AED/INTERCONNECT DIAGRAM		
DRAWN KDM	DATE 12-00	PART NO. 009502	
CHK'D	DATE		
SCALE NTS			ISSUE A
FILE: F\DRAWINGS\ACAD\O\009502			

ISSUE	DESCRIPTION	INITIALS	DATE
A	ECO #2527 RELEASE	KDM	12-00



ITEM	PART#	DESCRIPTION	QTY.
32	550774	OUTPUT CABLE, AED	1
31	800412	TAPE BLACK FOAM 1"X 216'#	2.12"
30	620470	COVER/AED MOTHER BOARD	1
29	140201	TIE WRAP 4 D"L X .0938W	1
28	620462E	RAIL/AED CASE FASTENER	2.61"
27	620462D	RAIL/AED CASE FASTENER	4.21"
26	620462C	RAIL/AED CASE FASTENER	6.22"
25	620462B	RAIL/AED CASE FASTENER	8.32"
24	620462A	RAIL/AED CASE FASTENER	8.62"
23	550772	CABLE, AED, DEFIB MAIN	1
22	550771	CABLE, AED MB-SERIAL, FFC	1
21	790055	FERRITE, FEC, D.610"	1
20	810149	DBL COATED FOAM TAPE .062	3/8"
19	550770	CABLE, AED MB-PREAMP FFC	1
18	800868	COATING, CONFORMAL, RTV	.001
17	100727	HIGH LOW 6X 3/8 PPH ZINC	5
16	800410	VELCRO, ONE-WRAP STRAP, WHT	X
15	800984	GASKET, CONDUCTIVE 1/16"	2.5 FT
14	100423	SCRW#4-5/16 PPH ZNC HI-LO	14
13	900410	BATTERY, 3V LITHIUM 1.8AH	1
12	570634	ASSY, AED FRONT ENCLOSURE	1
11	590374	PCB ASSY AED MAIN BOARD	1
10	611313	SEAL/AED HOUSING, PLATED	1
9	620468	BARRIER/AED PRE-AMP PCB	1
8	590375	PCB ASSY AED PREAMP	1
7	620478	BARRIER/ AED CAP ASSY	1
6	570633	ASSY, AED CAP BANK	1
5	601209	BRACKET/CAP MTG	2
4	620472	FOAM/CAP BANK MOUNT, AED	1
3	596395	ASSY, AED DEFIB MODULE	1
2	620467	BARRIER/AED DEFIB PCB	1
1	570635	ASSY, AED BACK ENCLOSURE	1

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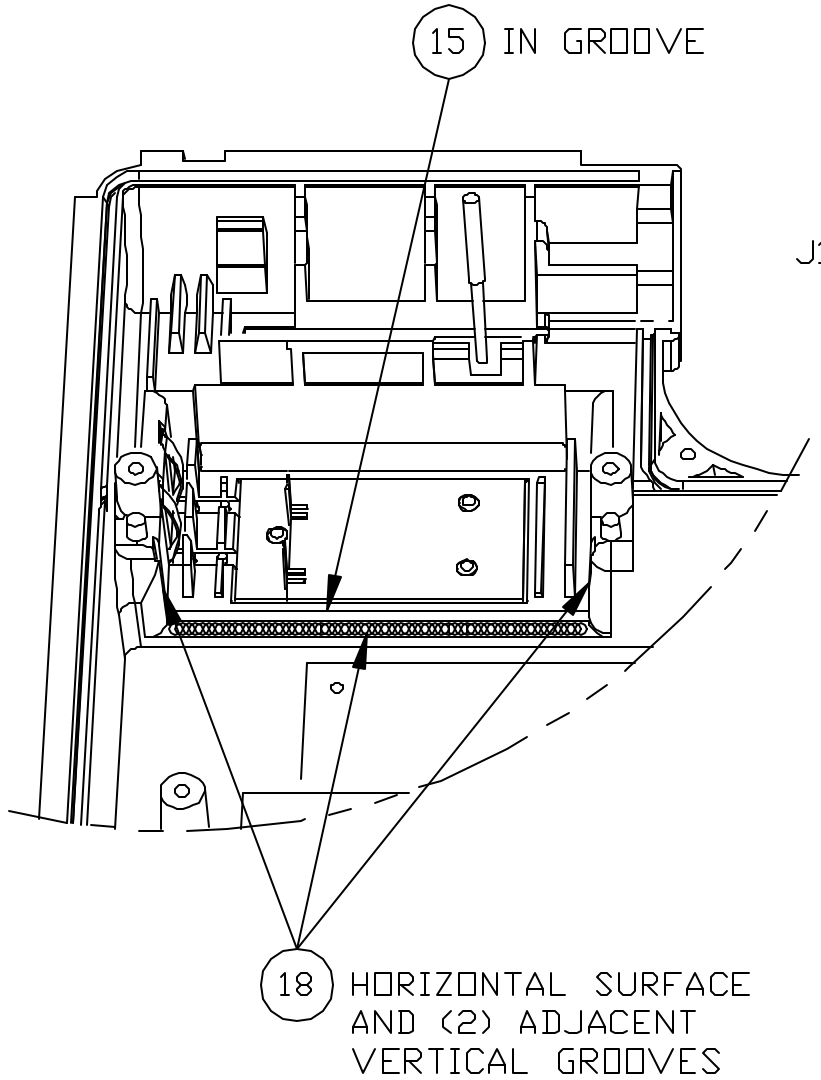
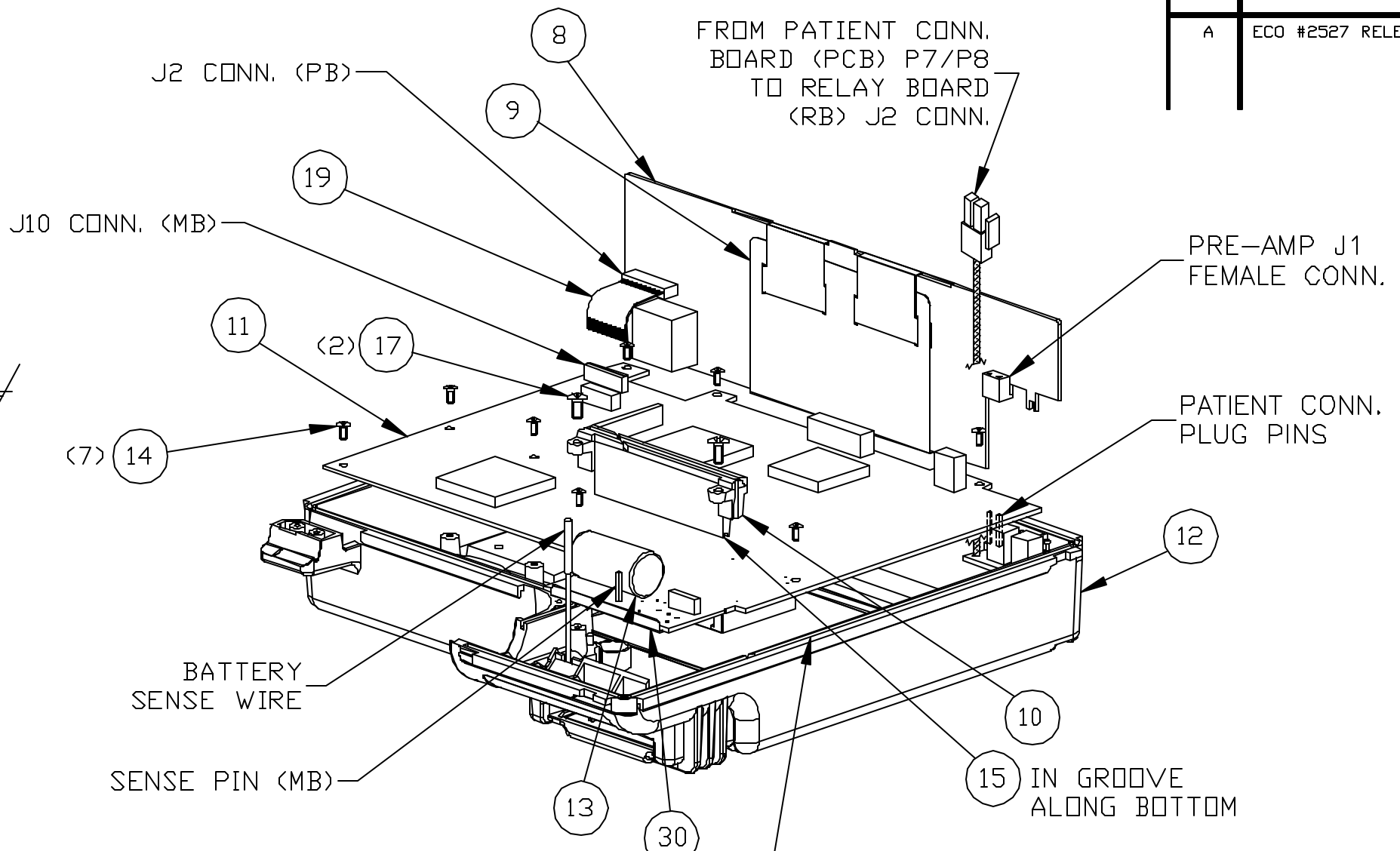
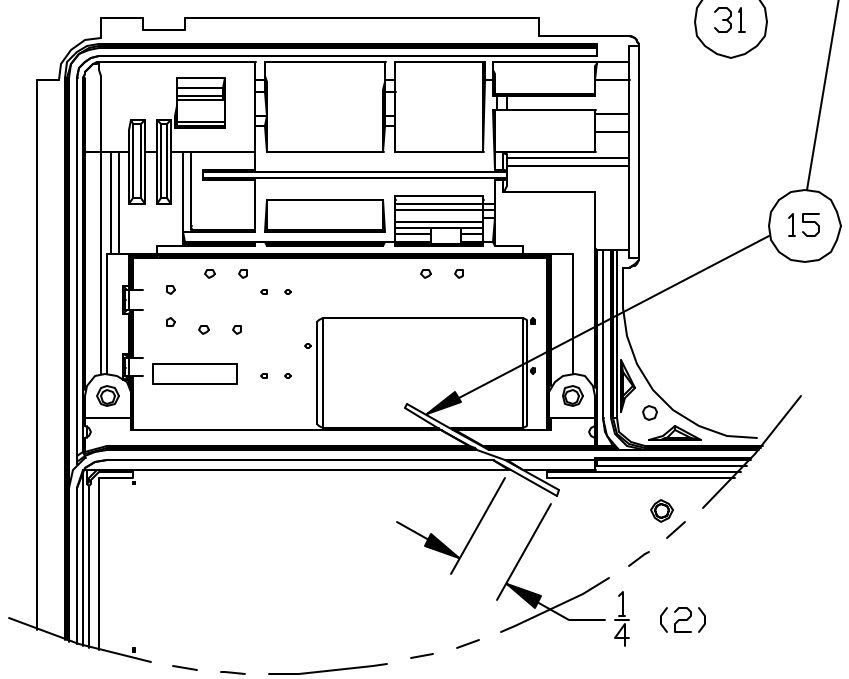
TITLE AED/SERVICE DRAWING

DRAWN KDM	DATE 12-00	PART NO. 990025	
CHK'D	DATE		
FILE:F:\DRAWINGS\ACAD\9\990025.DWG		SHEET 1 OF 4	ISSUE A

ISSUE	DESCRIPTION	INITIALS	DATE
A	ECO #2527 RELEASE	KDM	12-00







ITEM	PART#	DESCRIPTION	QTY.
31	800412	TAPE BLACK FOAM 1"X 216'#	–
30	620470	COVER/AED MOTHER BOARD	–
19	550770	CABLE, AED MB-PREAMP FFC	–
18	800868	COATING, CONFORMAL, RTV	–
17	100727	HIGH LOW 6X 3/8 PPH ZINC	–
15	800984	GASKET, CONDUCTIVE 1/16"	–
14	100423	SCRW#4-5/16 PPH ZNC HI-LO	–
13	900410	BATTERY, 3V LITHIUM 1.8AH	–
12	570634	ASSY, AED FRONT ENCLOSURE	–
11	590374	PCB ASSY AED MAIN BOARD	–
10	611313	SEAL/AED HOUSING, PLATED	–
9	620468	BARRIER/AED PRE-AMP PCB	–
8	590375	PCB ASSY AED PREAMP	–

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DRAWN KDM	DATE 12-00	PART NO. 990025
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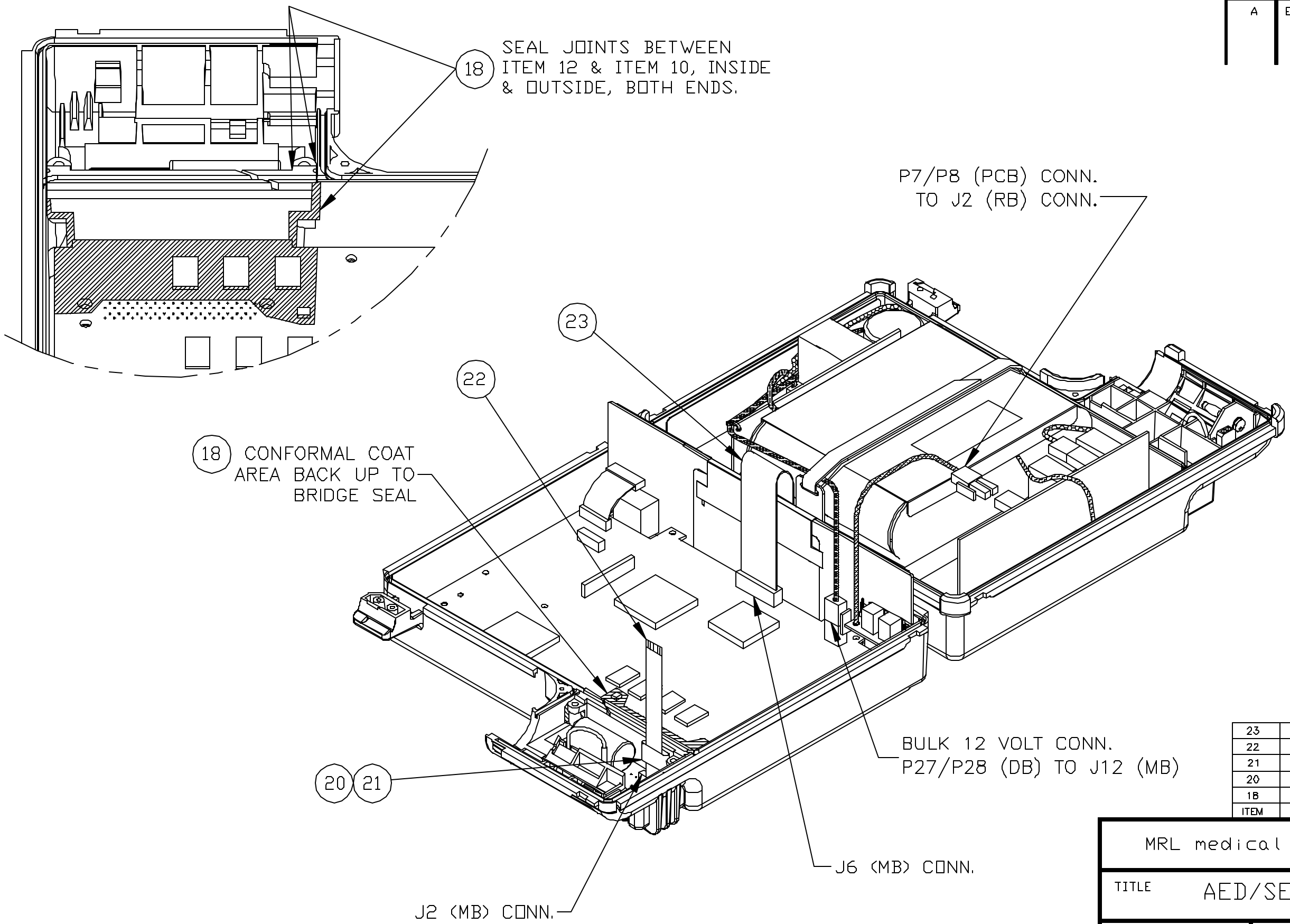
ISSUE	DESCRIPTION	INITIALS	DATE
A	ECO #2527 RELEASE	KDM	11-00


18
SEAL JOINTS BETWEEN ITEM 12 & ITEM 10, INSIDE & OUTSIDE, BOTH ENDS.
P7/P8 (PCB) CONN. TO J2 (RB) CONN.
23
22
18
CONFORMAL COAT AREA BACK UP TO BRIDGE SEAL
20
21
BULK 12 VOLT CONN. P27/P28 (DB) TO J12 (MB)
J6 (MB) CONN.
J2 (MB) CONN.

ITEM	PART#	DESCRIPTION	QTY.
23	550772	CABLE, AED, DEFIB MAIN	–
22	550771	CABLE, AED MB–SERIAL, FFC	–
21	790055	FERRITE, FEC, D.610"	–
20	810149	DBL COATED FOAM TAPE .062	–
18	800868	COATING, CONFORMAL, RTV	–

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TITLE AED/SERVICE DRAWING

DRAWN KDM	DATE 12-00	PART NO. 990025	
CHK'D	DATE		
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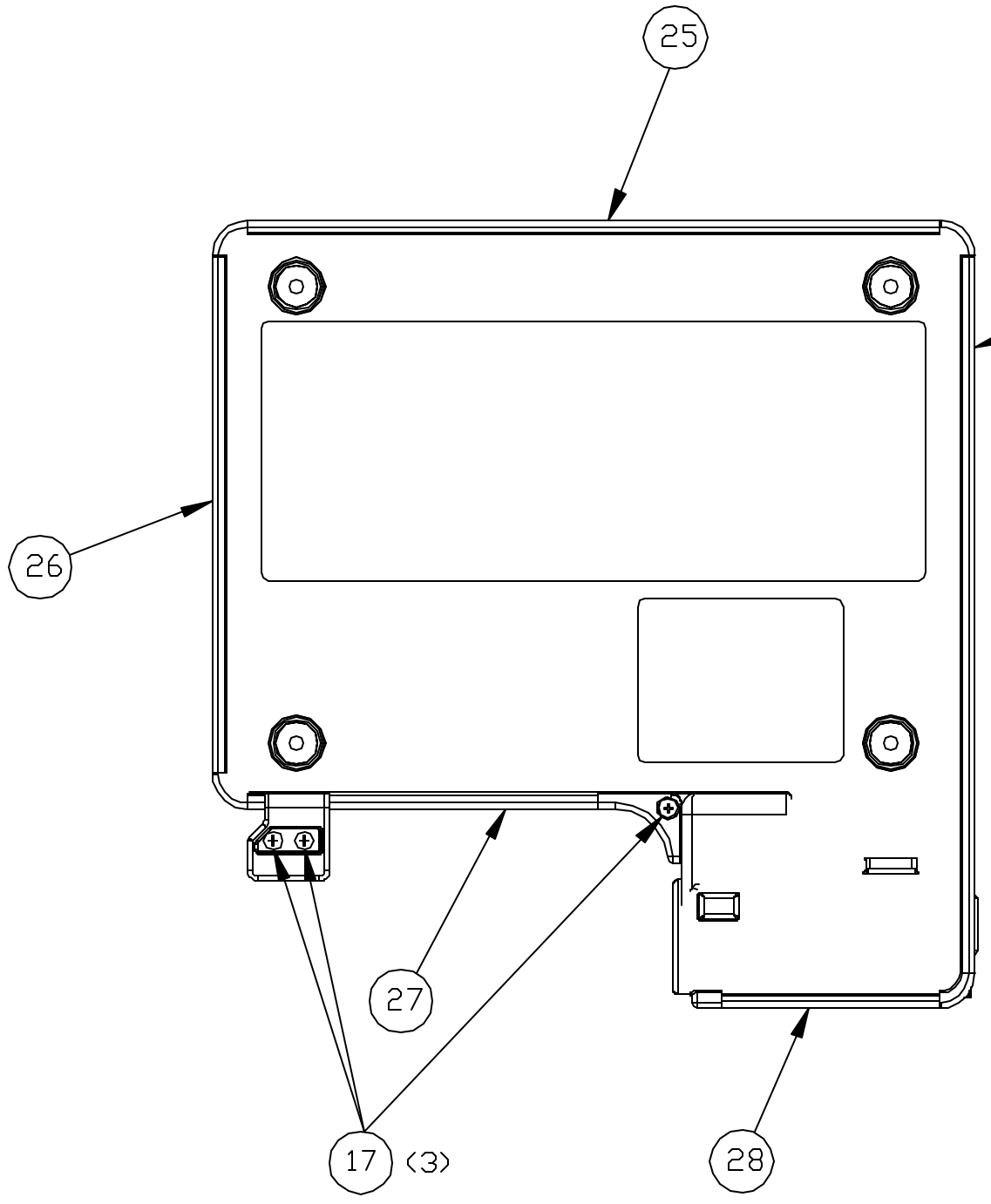
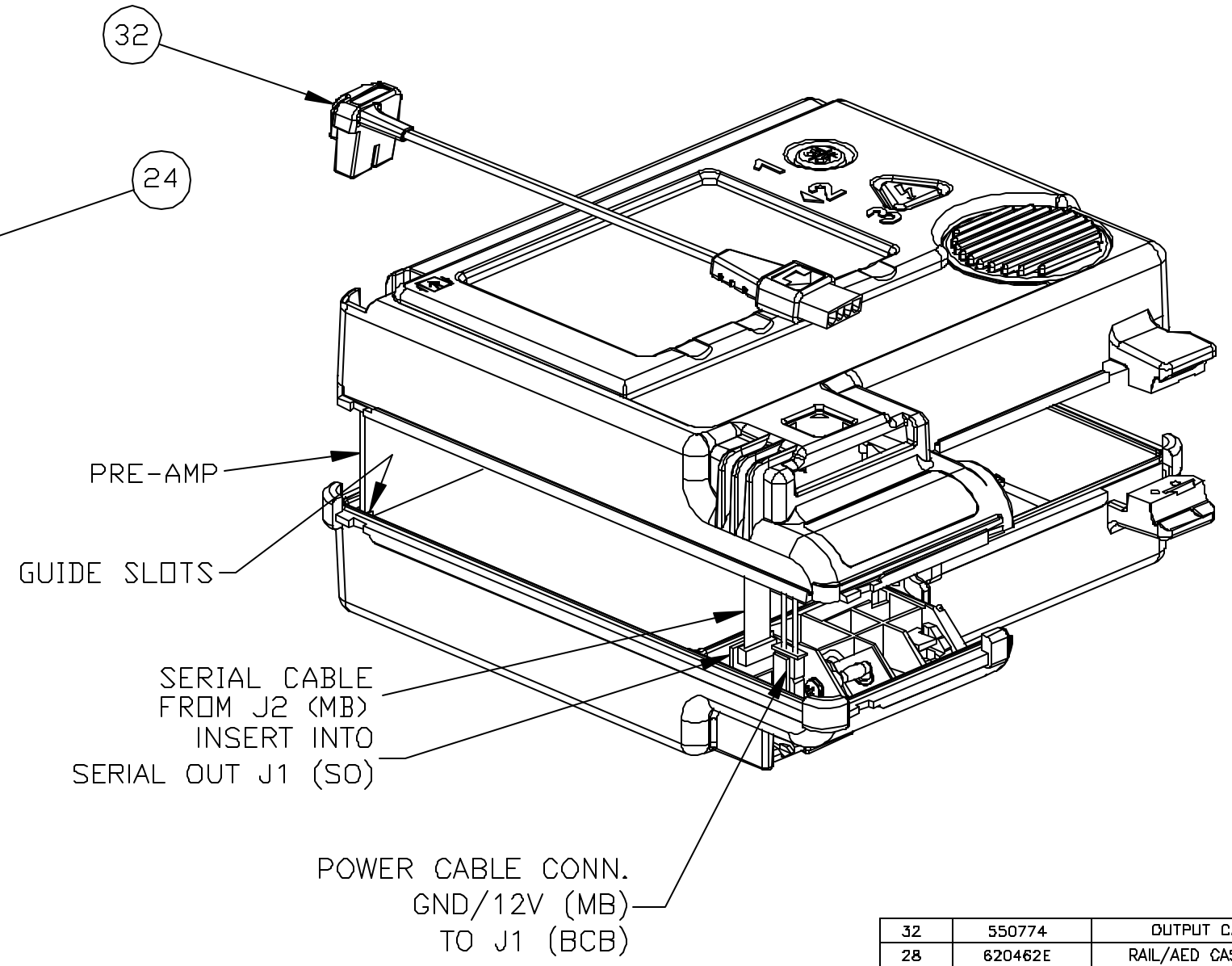
ISSUE	DESCRIPTION	INITIALS	DATE
A	ECO #2527 RELEASE	KDM	11-00





ITEM	PART#	DESCRIPTION	QTY.
32	550774	OUTPUT CABLE, AED	–
28	620462E	RAIL/AED CASE FASTENER	–
27	620462D	RAIL/AED CASE FASTENER	–
26	620462C	RAIL/AED CASE FASTENER	–
25	620462B	RAIL/AED CASE FASTENER	–
24	620462A	RAIL/AED CASE FASTENER	–
17	100727	HIGH LOW 6X 3/8 PPH ZINC	–

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TITLE: AED/SERVICE DRAWING

DRAWN	KDM	DATE 12-00	PART NO. 990025
CHK'D		DATE	SHEET 4 OF 4
FILE: F:\DRAWINGS\ACAD\9\990025.DWG			ISSUE A